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MARCH EXPORTS.

The general figures of electrical exports in March are of the same encouraging nature as those of earlier months in the year, even with a small decline in heavy electrical machinery, the amount of that item being $639,338 as compared with $699,261 in March, 1910. However, the exports of electrical instruments and apparatus were much larger than before, the value being $915,001 as compared with $783,371. Hence the grand total is $1,554,339 against $1,482,632, or a gain of $71,707. When it is remembered that gains are being made constantly, and have now continued so long, it is pleasant to note that they are maintained even while the general course of trade is slow and disappointingly dull. It is also curious to observe how political troubles affect business, for in both items Mexico falls behind last year to the extent of about $100,000 for the month. On the other hand, Japan, which took only $17,183 in heavy electrical goods in March a year ago, when feeling the full effect of her depression after the war, has risen to $131,600, while her demand for the lighter goods has risen also from $24,595 to $110,300. These are really impressive figures, and such gains if duplicated all along the line would indicate a revival of world-wide trade activity.

ELECTRICAL OPERATION OF A SHIPPING TERMINAL.

The use of motors in the handling of freight at important termini is a well-recognized source of economy not only in cost of labor, but in time, which is equally important in the transshipment of freight from rail to water transportation. In another column will be found a very complete account of the electrical equipment established at the water-front terminal of the Boston & Albany Railroad at East Boston. Several transatlantic lines stop there at the piers of the railroad company, and the recent installation is for the purpose of facilitating the transfer of freight from the railway to the holds of the steamers. A large part of the motor work is in connection with a grain elevator of 1,000,000-bushel capacity, although there is also a considerable conveyor equipment for general freight handling. The plant is especially interesting as an example of the extension of central-station service, since it was found in this case that the energy could be purchased from the central-station company more advantageously than it could be generated on the spot. The energy for the operation of the plant is, therefore, derived from the L Street generating station in South Boston, on the other side of the harbor. The energy is brought into the transformer stations by underground cables at 13,200 volts three-phase and distributed for motor work at 440 volts. Even at this fairly high voltage the cable installation is a heavy one, the supply for the grain elevator requiring no less than nine 1,500,000 circ. mil cables.

One unusual feature of the elevator equipment is the control of the three-phase motors. All of them save one for the passenger elevator are equipped with squirrel-cage secondaries. These give a highly efficient and extremely simple motor when oper-

ated at full speed, but require rather heavy currents at starting, so that a special and very practical system of starting has been installed for the entire building. Instead of reducing the starting voltage at each motor by a special transformer, the starting current is derived from a special set of auxiliary busbars arranged to operate at either 40 per cent or 58 per cent of the normal running voltage. When it is desired to start a motor the operator signals the switchboard annunciator for that particular motor. The switchboard operator then connects the motor to the auxiliary bus and then at the proper time transfers it to the full-voltage bus. When the circuit ammeter shows the motor is at full speed the switchboard operator signals back to the motor operator and the load is thrown on. Any motor can at once be stopped by a push-button control, and in addition a very ingenious stopping device is applied to the series of motors operating the grain distributors in the elevator. In case anything goes wrong the motor operator need merely press a button, when an automatic stopping mechanism at the switchboard cuts out in proper succession all the conveyor motors so that there will be no piling up of the grain at any point of the system when an emergency stop is made. The conveyor is thus left in proper condition for starting whenever the particular trouble is remedied. The elevators are equipped with shoveling machines for emptying cars and with car-pulling drums for handling the loaded cars in the elevator so that there is no necessity for sending steam locomotives further than the convenient tracks outside.

In addition to the elevator equipment there is a considerable equipment of motors for other service and also of lamps for lighting the piers and offices. The piers are lighted by well-distributed tungsten lamps. A particularly ingenious part of the lighting equipment is the installation of a series of switches whereby the night watchman on duty at the piers can always keep a lamp lighted ahead of him while on his beat, so that there is no occasion for carrying a lantern on the piers. A very complete motor-driven fire-protection plant is installed for service on the piers, and experiments are being made with remote control of the water valves so that in case of fire a push button at any hose valve will immediately turn the water into the dry-pipe systems and permit their prompt use. Altogether the electrical equipment of the piers is remarkably complete and efficient and the automatic switching devices for various purposes are exceptionally ingenious and well planned. The whole installation is one of great value to the shipping facilities at the East Boston piers and is a part of the plan to make these piers a great transatlantic terminus. Recent railroad combinations and connections whereby large amounts of Western freight will be delivered at this point add greatly to the industrial importance of the whole plant.

PERIODIC VARIATIONS OF LAMP-FILAMENT RESISTANCE.

It is very evident that with an alternating current in an incandescent-lamp filament the temperature of the filament will not be quite steady, as in the case of the corresponding strength of continuous current supply. The filament's temperature will throb slightly, with a frequency double that of the current. If the resistance of the filament were constant at all temperatures, this throbbing of the temperature would not affect the current strength. But since the resistance of a filament does vary slightly with the temperature, even when the latter is very high, and especially in the case of metallic filaments, it follows that the wave-form of the current must be more or less affected thereby. Consequently, the wave-form of the lamp current will not be identical with that of the terminal potential difference, although the difference may not be very marked.

In an article on this subject by Mr. O. M. Corbino, recently published in the *Physikalische Zeitschrift*, a very ingenious experimental demonstration is made of this derivation in current wave-form, with the aid of the Braun-tube oscillograph. The cathode beam is operated upon electromagnetically, so as to deflect the spot of light on the fluorescent screen; but instead of producing the usual deflecting action by the full current strength, in the ordinary way, a differential action is produced between the current supplied to the lamps under test and the current supplied to a parallel circuit containing an unvarying resistance. The resulting electromagnetic action virtually magnifies the deviations in the lamp current due to resistance variation, and the oscillographic picture so presented enables the cyclic oscillation in the temperature of the filament to be determined. According to the measurements cited in the article, the maximum cyclic variation of temperature in 16-cp, 105-volt osram lamps was 15 deg. C., and in 32-cp osram lamps 10 deg. C., the frequency of the alternating current being 42 cycles per second. With a frequency of 60 cycles per second, as used in the United States, such lamp filaments should show still smaller oscillations of temperature. The experiments are interesting not only for the sake of the measurements they contain, but also as indicating the development attained in the use of the Braun-tube oscillograph. At first, this instrument was used merely as an indicator of the deviating influence of a magnetic field on cathode rays. Later, quantitative measurements of this deviation were produced. The next step was to make the instrument a photographically recording oscillograph. After that it became, in the hands of Professor Ryan and others, a recording wattmeter. In the research here considered it becomes a differential-current oscillograph.

DIRECT VERSUS DIFFUSED LIGHT.

If one wishes to stir up a lively discussion at any meeting of illuminating engineers it is only necessary to bring up the question of direct versus diffused light. Diffused light is also commonly known as indirect light and is received by diffuse reflection from various solid surfaces, or from the sky or clouds. Most of our lighting, both natural and artificial, is a combination of direct and diffused. The war mainly wages over which should have the preponderance in artificial lighting. The advocates of both methods fall back on analogies to natural lighting in support of their claims. The advocates of diffused or indirect artificial lighting systems point to the fact that daylight as it is ordinarily received in occupied rooms is practically all diffused light. To be sure, there is a certain amount of direct sunlight on clear days, but it is seldom utilized for working purposes, as the common use of window shades demonstrates. Daylight, as we ordinarily use it inside of buildings, is really diffused lighting from sky and clouds, sometimes filtered through diffusing ceiling-windows, but more frequently through side-wall windows. The opponents of the diffused artificial lighting idea point, on the other hand, to the fact that the world seems more cheerful to the majority of individuals and animals when there is direct sunlight, and that the diffused light of a cloudy day has a generally depressing effect. If we are to take outdoor lighting as indicating the ideal in artificial

lighting, it would appear that we should have to provide for combination direct and diffused lighting most of the time, and for diffused lighting the remainder of the time. If we accept existing daylight lighting conditions as an acceptable ideal toward which to work with artificial lighting, there is evidently no argument against diffused lighting in itself. The main room for argument is as to the method of its application.

The engineering calculations relating to a particular form of indirect lighting, involving the use of incandescent lamps surrounded by inverted reflectors for directing the light upward toward a diffusing ceiling, are discussed in an article by Mr. James R. Cravath in this issue. In contradistinction to the point-by-point method of calculation which would prove cumbrous in indirect illumination problems, the author employs a method which can best be designated as wholesale, in that it treats the problem as a whole rather than in parts. Such a method is well suited for use with illuminating problems involving single or multiple reflection and should give reliable results when the experience coefficients are selected with due regard to the conditions under which the lighting equipments will be employed. The author has observed that the efficiency of delivery of light from the lamp to the working plane in medium-size rooms varies from about 29 per cent to 37 per cent, according to the character of the reflecting surfaces, thereby indicating an absorption of from 71 per cent to 63 per cent. It would seem that by selecting the proper absorption coefficients according to the character of the reflecting surfaces one could readily determine the efficiencies for any chosen arrangement of indirect lighting installation by means of the wholesale method.

CHROMATIC ABERRATION AND VISUAL ACUITY.

It is now generally believed on experimental grounds, and has long been supposed, that different colors of light travel through space with the same speed, at least within the limits of the visible spectrum; so that, for example, a momentary gleam of red light and a similar momentary gleam of blue light, emitted simultaneously from the sun, would reach the earth simultaneously. On the other hand, it is well known that inside transparent material substances, such as water or glass, the speed of light is not only lowered, but lowered differently for different colors; so that, in general, the colors toward the violet end of the spectrum are retarded more than those toward the red end. The analysis of white light into a variegated spectrum band, on passing through a prism, is, in fact, attributable to this differential retardation within the substance of the prism. It follows from the above fundamental facts that when any simple lens is accurately constructed of a single uniform transparent substance, such as flint glass, the focus of the lens is different for rays of different colors. The violet rays, being the most delayed, will come to a focus nearer to the lens than the red rays. Consequently, a luminous image in white, or heterochrome light, formed by the lens, will have a rough and variegated border, whereas in homochrome light the image so formed might be sharp and homochrome. This defective focusing of a lens, due to the different refrangibilities of different colors of light, is known as chromatic aberration. It naturally constitutes a serious difficulty in the constructon of telescopes, since it tends to produce star images that instead of being sharp and white are blurred and fringed with color.

In the case of the telescope, and of optical instruments generally, chromatic aberration is reduced to a working minimum by using compound lenses, or lenses comprising a plurality of transparent elements in series, usually cemented together so as to form a solid aggregation, the refractive qualities of the different elements being different and compensatory, so as to annul mutually their individual chromatic aberrations and to produce an achromatic combination. For instance, one element of the compound lens is of flint glass and the other of crown glass. The accurate predetermination of the various surfaces in large achromatic compound lenses constitutes a large and complex field of applied mathematics. In the structure of the human eye there is in effect a compound lens, one element of which consists of aqueous humor in a lenticular chamber fronted by the cornea, and the second, the more important, element is the crystalline lens. It has been held, largely on supposition, that this combination of elements results in an achromatic compound lens. Nevertheless, physical analysis of the eye as an optical instrument has long since demonstrated that the chromatic compensation is far from being complete, and that a certain amount of chromatic aberration should be expected in the optical apparatus of the eye. In other words, it has long been known that the artificially created telescope is far superior as an achromatic mechanism to the natural eye of man, in spite of the fact that the former is only 300 years old, whereas the latter has been worked on by Nature for many millions of years. Nevertheless, it is only fair to recognize that if the mammalian eye possesses very distinct chromatic aberration the ordinary mammal is contentedly unconscious of the fact.

In a very interesting article in this issue Dr. Louis Bell describes certain simple experiments by which he demonstrates to any contented man the reason for discontent in the possession and inheritance of a chromatically aberrant eye. He shows that in daylight, with its preponderance in the yellow, the tendency is for the eye to focus on the yellow light and ignore the imperfect focusing of the red and blue ends of the spectrum, an absentmindedness that is much helped by the relatively feebler sensibility of the return to those extremes of color. Consequently, the ordinary man derives focal and optical comfort from pursuing a middle policy in regard to the color spectrum. The remarkable proposition that Dr. Bell's observations point to in connection with the mercury-vapor light is that the well-known utility of this light for drafting, and for scrutinizing purposes in general, is largely attributable to its being essentially monochromatic; so that the chromatic aberration of the eye is eliminated, and so that all of the rays focus sharply on the retina. This is a startling proposition to a believer in the natural perfection of human sensibilities, but the evidence as presented in the article is strong. If the reading value of a homochrome light is nearly double that of an ordinary heterochrome light, the economy for reading purposes of homochrome light sources is virtually increased in like measure, and their gain, from a purely utilitarian standpoint, is as though they consumed only half their recorded power. In other words, if 2 ft.-candles is the illumination necessary for satisfactory reading with heterochrome light, then only a little over 1 ft.-candle is required with homochromatic light, with a corresponding possible economy in power consumption. Of course, from an esthetic viewpoint, the argument is all the other way, because it is known that for comfort and a pleasurable outlook on our immediate environment a white light is desirable and, esthetically, a monotonous homochrome light is an abomination of desolation.

Denver-New York Telephone Connection.

By the use of Pupin loading coils telephonic communication between New York and Denver over a distance of 2000 miles was begun by the American Telephone & Telegraph Company on May 8. Use is made of phantom circuits so that multiplex telephony and telegraphy can be employed simultaneously over the same wires without interference. Between New York and Chicago, and between Omaha and Denver, there are two separate parallel metallic circuits which are operated in phantom; between Chicago and Omaha there is only one circuit, so that multiplex telephony cannot yet be employed between these two points.

No. 8 copper wire is used to obtain the highest practicable telephonic circuit conductivity. The old glass insulators have been replaced by about 285,000 porcelain insulators in order to minimize the leakage. The capacity has been neutralized satisfactorily by inserting Pupin inductance coils at 8-mile intervals. It is estimated that the changes introduced involved a cost of about $100,000. At present the charge for telephoning between New York and Denver will remain at $11.25 for each three minutes, which rate has been in use for some time for telephoning on the relay plan.

Transportation Arrangements for N. E. L. A. Convention.

Arrangements for transportation to the National Electric Light Association convention in New York from May 29 to June 2 have been completed by Mr. C. D. Hodskinson, as master of transportation for the association. Reduced fares have been authorized to New York City for the occasion by the following passenger associations: Trunk Line, New England, Central, Eastern Canadian, Southeastern and Transcontinental. For all of the associations with the exception of the one last mentioned the fare for the round trip will be one and three-fifths of the single-trip first-class fare, the return trip tricket to be issued on the certificate plan, with an extra charge of 25 cents for each certificate viséd. The Transcontinental Passenger Association, which embraces the States of California, Oregon, Washington, Arizona and Nevada, and also British Columbia, has authorized the sale of round-trip tickets from the Pacific Coast and adjacent states and from British Columbia. The fare for the round trip from main-line points in the States of California, Washington and Oregon and from British Columbia will be $108.50, with slightly less fares from intermediate points in Arizona and Nevada. These tickets will be on sale beginning May 16. No special reduced fares have been authorized by the Western Passenger Association and the Southwestern Passenger Association, which embrace the territory west of Chicago, Peoria and St. Louis, and include the States of Idaho, Utah and New Mexico, and the territory southwest of St. Louis, including Texas, Arkansas, Oklahoma and Missouri (south of the Missouri River) and Louisiana (west of the Mississippi River).

The territory of the associations authorizing reduced fares covers the States of New York, New Jersey, Pennsylvania, Maryland, Delaware, West Virginia, Maine, New Hampshire, Vermont, Massachusetts, Rhode Island and Connecticut; the District of Columbia; the territory west of Buffalo, Pittsburgh, Wheeling, Parkersburg and Huntington, to and including Chicago and St. Louis, and north of the Ohio River, including Cincinnati, Louisville and Cairo; the territory in Canada east of and including Port Arthur, Sault Ste. Marie, the St. Clair and Detroit Rivers, and the territory south of the Ohio and the Potomac and east of the Mississippi River.

For the convenience of those intending to attend the convention it should be stated that full one-way first-class fare tickets can be purchased to New York on the certificate plan at numerous railway stations not earlier than May 25 (May 26 from Southeastern points) and not later than May 31. The purchaser should obtain a certificate when buying the ticket. These certificates should be deposited with Mr. Hodskinson, as master of transportation of the association, immediately upon reaching the headquarters of the association in the Engineering Societies Building, New York City. The address of Mr. Hodskinson until the opening of the convention will be 70 State Street, Boston, Mass.

Members of the New England Section of the National Electric Light Association have received a notice from Mr. Harry M. Hope, assistant master of transportation, 147 Milk Street, Boston, Mass., setting forth the arrangements being made for the running of a special train from Boston to New York on May 29, in connection with the forthcoming convention. The New England Electric Light Special will leave the South Station, Boston, at 10:02 a. m., on May 29, leaving Providence at 11:06 a. m., New London, 12:36 p. m., and New Haven, 1:45 p. m., arriving in New York at 3:30 p. m. The train will consist of two dining cars, one buffet smoking car, one baggage car and a sufficient number of parlor cars to provide adequate space for all the New England members. The train will be equal in every respect to the best limited trains running between Boston and New York, and special tickets for it will be issued which will entitle the holder to a special luncheon on the train, with a souvenir menu, in addition to transportation accommodations. A round-trip rate of fare and three-fifths on the certificate plan has been granted by the New England Passenger Association from all points in the territory governed by that association to and from New York. Tickets sold on the plan will go on sale May 25 to 31 and will require the holder to begin the return journey not later than midnight, June 6, and call for a continuous journey. It is planned to make the special train the finest ever sent out of the New England States. The cost of the service will be less than that on the best limited trains, and only 132 passengers are required to guarantee the provision of the special train.

Electricity Supply on the Isthmus.

A new 500-kw, 2200-volt, three-phase, 25-cycle turbo-generator is to be installed in the electric generating and air-compressor plant near East Balboa on the Isthmus of Panama, replacing all of the present electrical generating equipment at that point. A recent accident to the plant curtailed the production of electrical energy for lighting purposes and the Pacific Division plant at Miraflores has been carrying part of the night load. The East Balboa plant has been supplying alternating current for lighting in Ancon, Balboa and East Balboa and direct current for the operation of the cranes on the Panama Railroad wharf and for the motors in the Pacific Division machine shop. These motors will be superseded by alternating-current machines when the new generator is in operation.

The committee of engineers which had the matter in charge considered the feasibility of furnishing all electrical energy in the area between Balboa and Pedro Miguel (Pacific Division) from the Miraflores station, but it was concluded that this plant could not assume the extra day load safely without danger of interruption to the work on the Pacific Division. Under the new arrangement the Balboa and Miraflores plants will be operated in parallel. The former will carry its present day load, the steam turbine of the new generator being driven by the exhaust steam from the air compressors. This will not only constitute a fuel economy, but obviate any necessity for additional boiler capacity. The Miraflores plant will assume the night load. In addition to the electricity required at Balboa during the day there is sufficient energy in the exhaust steam to enable the Balboa plant to transmit from 100 kw to 200 kw to the system now operated by the Miraflores plant.

It has also been recommended by the committee that the present circulating-water system for the condenser at the Balboa plant be retained, but that a centrifugal pump driven by an electric motor be substituted for the circulating pump now in use.

Oil-Switch Patents Decision.

The United States Circuit Court of Appeals for the First Circuit, sitting at Boston, has issued an opinion sustaining the General Electric Company in suits involving Frank O. Hartman et al., regarding oil-switch patents 800,916, 789,597 and 714,436. The court holds that Messrs. Hewlett and Emmet, of the General Electric Company, for the first time conceived the idea of supporting the switch structure independently of the oil tank, so that the latter could be detached from the switch merely by unfastening it. The oil-submerged switch necessarily consists of two parts, the operative switch and the comparatively inert oil tank. Before the work of Hewlett and Emmet these parts had been so connected that their separation, though often necessary, was difficult and took time. Hewlett and Emmet made separation easy and rapid without affecting the operation of the switch as a switch, of the oil as oil, or of the tank as a tank. Except as to arcing, the switch worked much as if it were in air. Patentable invention of a meritorious sort is found. The General Electric Company is also sustained in the further development by Hewlett and Emmet of the plan of mounting the movable element of the switch or circuit-breaker, so that in opening the circuit it takes a downward movement in the oil, thereby effecting the contact on the under surface of the fixed terminal, which is rendered self-cleaning by the engagement of the parts, and from which the carbon falls and settles in the bottom of the containing vessel. By reason of this downward movement of the movable contact the arc is stretched through a progressively increasing depth of liquid, thereby subjecting the arc stream to increasing pressure and also giving the insulating vapors developed a longer path to travel in the cool liquid before reaching the air. This results in a decreased fire hazard, since it sometimes happens that the vapors liberated by the heat of the arc escape in sufficient volume to reach the top of the vessel and may be ignited there. The court holds that any conception and device which furnishes means for removing even slight interferences with the successful operation of the high-potential switch as a contrivance for controlling powerful and dangerous currents of electricity, and which in any degree, however slight, lessens fire hazard, presents an important improvement in the art pertaining to the use of electricity. The lower court held that these improvements might have reasonably resulted from the exercise of ordinary mechanical skill, but the upper court holds that such questions as the better effect of the electrical contact in the upper part of the vessel, where the oil is cleaner, the effect of lengthening the arc, and the effect of forcing developed insulating vapors to a longer travel in cool liquid before reaching the air are not problems for the ordinary skilled mechanic, but questions which enter into the broader inquiry whether the art is advanced through an inventive idea which suggests and provides a better and safer use of an exceedingly dangerous force.

Central-Station Progress in Massachusetts.

Figures deduced from the returns filed by central stations with the Massachusetts Gas & Electric Light Commission show that rapid expansion in the uses and purchase of electricity characterized the fiscal year ended June 30, 1910. From the proof-sheets of the forthcoming annual report of the commission it appears that the total income of the electrical supply companies of the State for 1910 was $11,206,004, compared with $10,558,070 in 1909, or a gain of 6.1 per cent. The gain of 1909 over 1908 was only 1.5 per cent. The principal source of earnings was the sale of energy for commercial arc and incandescent lighting, which totaled $6,505,692 for 1910, compared with $5,943,998 in 1909. A substantial gain also was enjoyed in the sale of energy for motor service, the 1910 income being $2,313,393, and that for 1909 $1,949,460. The popularity of the incandescent electric lighting in public street illumination is indicated by a decrease in sale of energy for municipal electric arc service from a total of $1,450,637 in 1909 to $1,400,028 in 1910. The income from public incandescent electric lighting on the other hand rose from $522,032 in 1909 to $575,251 in 1910. In the past two years the amount of income derived by Massachusetts central stations from the sale of energy for municipal arc lighting has decreased by about $79,400, the incandescent street-lighting income having increased by about $87,000. In the past two years the revenue derived from steam-heating service has risen from $26,368 to $29,827. The sale of lighting energy by contract rates has greatly decreased during the past year.

The total operating expenses for 1910, exclusive of interest, depreciation, dividends and sundries, were $6,738,093, contrasted with $6,279,046 in 1909. The net profit for 1910 was $4,467,911, and the gas companies made $817,986 of this profit in their electrical departments, leaving a profit of $3,649,925 for the purely electric companies. Income from rents, jobbing, etc., amounted to $544,881, making a total for the electric companies of $4,199,806, compared with $3,641,142 in 1909. From the foregoing were made interest charges of $428,929; dividends, $2,411,202; depreciation, $425,969, and sundries, $785,578. The apparent net profit for the year was $143,128.

The most important single items in the operating expenses for the year 1910 were: Coal, $1,255,700; taxes, $963,766; wages of operators at stations, $653,807; repairs and renewals of lines, $535,818; general salaries, $515,925; wages for care of lamps and meters, clerical labor in distribution department, and salary and commission of collectors, $373,908; general office expenses, $372,258; incandescent lamps, $326,979; salaries of officers, $247,057; energy purchased, $233,108; insurance, $173,198; steam-plant repairs, $151,910; rentals of real estate used for plant, $127,852, and repairs and renewals of meters, lamps and motors, $113,175. The tendencies in these items from year to year reflect the lines of economical administration which are being followed in Massachusetts, and it is noteworthy that so large an increase in revenue should be secured with an added fuel expense of only $50,000 for the entire State. The approximate total energy generated and delivered at the switchboard for the year was 240,000,000 kw-hours. The magnitude of the item of taxes in comparison with station-labor cost is an impressive index of the extent to which the central station is contributing to the support of the municipal and State governments. Taxes were nearly 50 per cent greater than station wages and about three-quarters as large as the fuel expense. In the past two years taxes have increased about 18.5 per cent in total amount in Massachusetts central-station practice. The tendency for station-labor cost to decrease from year to year in spite of greater total outputs of energy is due in large measure to the concentration of generating plants in large installations of high efficiency.

Hydroelectric Development at Mammoth Spring, Ark.

Mammoth Spring, Ark., is the largest spring in the world. Its surface area is eighteen acres. Its origin is a mystery, as its source is in subterranean waters. The depth has been sounded 96 ft. with an anvil and then the underground current was so strong the plummet could go no further. The flow of water is uniformly regular and constant and amounts to about 500,000 gal. of pure water daily.

In 1854 John A. Deadrick built a little 4-ft. dam to get enough fall to grind a grist of corn. This was all the work this enormous spring did until in 1881 the Mammoth Spring Improvement & Water Power Company purchased the spring and built a dam of cut stone across its outlet. In this manner 800 hp was developed, a portion of which was utilized to run a cotton mill. The following year the Mammoth Spring Flour Mill was erected with an output of 500 bbl. daily. All the output of this mill was shipped south. In 1898 a second dam was built about 2 miles below the first one. This dam was a plain wooden structure, but power was developed to light up the town

of Mammoth Spring and also Thayer, Mo., just over the State line.

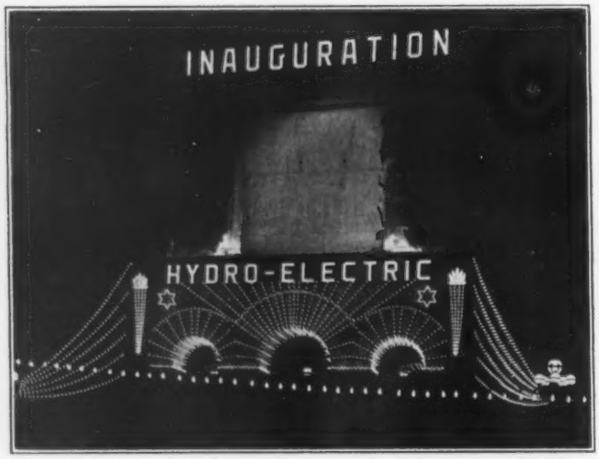
In 1907 Mr. E. C. Bellamy became general manager of the Mammoth Spring Light & Power Company. He found by actual measurement that the fall of Spring River is 10.4 ft. per mile for the first 16 miles down stream, so he soon determined to build a modern dam below the second dam and develop sufficient power to be transmitted to distant points. The new dam was begun in 1908 and is now completed. It is 610 ft. in length with a 24-ft. head and a net working head of 19.5 ft. The present equipment consists of one 300-kw generator and one 150-kw generator with space for increased installation. These generators are directly connected to two pairs of 35-in. horizontal waterwheels. The transmission line to Mammoth Spring consists of white cedar poles, storm-guyed, with porcelain insulators, galvanized hardware and lightning arresters, No. 0 bare copper wire, the transmission emf being 2200 volts. It is part of the present plan to extend the line as far north as West Plains, Mo., and from Mammoth Spring, Ark., up to this point No. 4 bare copper wire will be used at an emf of 33,000 volts.

A total of 2600 hp has been developed now, and it is expected to develop eventually 20,000 hp. The towns of Mammoth Spring, Ark., and Thayer, Koshkonong, Brandsville, Fruitville and West Plains, Mo., will be illuminated by means of the power thus developed on Spring River.

A huge electric sign will be erected over the power house at dam No. 3. A similar sign will be placed near the station at Mammoth Spring, Ark.; another at Brandsville, Mo., and still another at West Plains.

Official Inauguration of Toronto Hydroelectric System.

The official inauguration of the Toronto hydroelectric system was celebrated May 2. The ceremonies commenced with a banquet at the King Edward Hotel, Toronto, which was attended by the Mayor, Board of Control and City Council of the city of Toronto, the Cabinet Ministers of the Province of Ontario, the members of the Hydroelectric Power Commission, together with representatives of the city electrical department and a number of prominent citizens and guests from out of town.



Illumination in Toronto on Inauguration of Hydroelectric Service.

The street lamps of the Toronto hydroelectric system have been in service for some time, but for the occasion of the inauguration they were turned out and the route from the King Edward Hotel, where the banquet was held, to the city hall, was lined by torch-bearers 20 ft. apart on both sides of the road. The red fire of their torches gave an exceedingly striking appearance to the streets.

The button was pressed by Sir James P. Whitney, Premier of Ontario, who used for this purpose the finger of the Honorable Adam Beck, in graceful acknowledgment of the activity of the latter gentleman on behalf of the hydroelectric power movement in Ontario. At the moment of pressing the button the entire street-lighting system was turned on and the decorations shown in the illustration were lighted. The principal feature of interest in these decorations was a miniature imitation of Niagara Falls, the source of the city's electric supply—90 miles away. The banks of the river were represented by painted scenery and the falls themselves by real water illuminated by white and green beams from searchlamps placed on adjoining buildings. Eight searchlamps (not shown in the illustration) were placed in the city hall tower and produced a most striking effect.

The crowd which witnessed the celebration was variously estimated at from 40,000 to 100,000. After the button had been pressed a reception was held within the city hall and a number of citizens visited the electrical department, where light refreshments, cooked by electricity, were served.

Arkansas Public Utility Convention.

The Arkansas Association of Public Utility Operators met in fourth annual convention at the Marion Hotel, Little Rock, on May 3. With ideal weather conditions the convention opened on Wednesday morning for registration of members, and in point of numbers in attendance this convention broke all records for the Arkansas association.

The regular work of the morning session, consisting of reports of committees and the president's address, was deferred till after the afternoon session and the forenoon was very pleasantly spent in renewing old friendships and forming new ones.

At 2 p. m. President Byron C. Fowles, of Pine Bluff, called the convention to order and Mr. W. W. Wood, Jr., general manager of the Texarkana Gas & Electrical Company, presented a paper on "The Effect of Natural Gas on Municipalities." Mr. Wood outlined the rapid growth and development of the cities in older natural gas districts and predicted great benefit to the State of Arkansas from the pipe line now being built from the Caddo (La.) fields. All the principal cities from Little Rock south will be connected by branches to the main pipe line leading to Little Rock. After counting over the many advantages of gas as a domestic and commercial fuel the author called attention to the great saving effected by its use in the electric plant at Texarkana. The saving is shown in cost of fuel, labor and boiler maintenance. The ease of regulation renders the gas-fired boiler almost automatic and the steady, uniform fire enables the boiler to operate at higher loads than when coal-fired. Another advantage is the freedom from necessity of expensive coal handling and storage facilities. For emergency use a tank of fuel oil is provided and oil burners are piped into each boiler. Once a week these oil burners are started and are used to carry the station load for about one hour.

Discussion by Messrs. Hegerty, Fowles, Mitchell and Riedel brought out the information that the Caddo gas fields are considered the largest yet opened and, Mr. Wood thinks, will not be exhausted in twenty years. Mr. Wood stated that $700 covered the expense of equipping his boilers with the "Equitable" burners and that the saving effected was about $13,000 during the first year. He recommended the use of gas with not to exceed 7 oz. pressure and explained in detail the necessity of care in proper mixture of air with gas to secure the highest efficiency.

In answer to a question about gas lighting the author stated that the great heat of natural-gas light prevented its use, especially in the South. Practically all of about 250 customers who changed from electric lighting to gas lighting on the advent of cheap gas were glad to return to electricity during the first summer following.

Following the discussion of Mr. Wood's paper Mr. J. M.

Hewitt, manager of the Mariana Light & Power Company, presented a paper entitled "The Rate Question," tracing the developments of rates for electricity. He emphasized the fact that all costs should be determined and, after adding only reasonable profits, such rates should be adopted that all classes of business would produce about equal returns. Rates should be so made as to invite new business, especially that with desirable load characteristics. The author showed the desirability of proper accounting, so that whenever one's rates are brought into public discussion the reasonableness of those rates can be proved.

In the very general discussion following the reading of this paper the consensus of opinion was that a company's books should not be so exposed to the public that the political demagogue might derive information to use in fighting the company, but that only before a court of proper jurisdiction should they be opened. Mr. Hewitt recommended that a competent outside engineer, acceptable to the City Council and to the company, be brought in and made arbitrator in any rate controversy. Mr. Wood advised the use of extreme tact and diplomacy in the treatment of all public relations, as well as absolute fairness and squareness.

Mr. W. C. Maguire, manager of the Arkadelphia Electric Light & Water Company, read a paper on "Water." This paper outlined the disadvantages of the flat water rates and the great desirability of getting meters and meter rates established. The author also pointed out the necessity of pure and constant supply through a correctly designed and maintained system. In the discussion Mr. Hegarty referred to the governmental policy of water conservation, expressing the hope that this policy will be so modified as to allow development to proceed wherever desirable.

The practice of rendering water bills quarterly was criticised, and then the method of "continuous-meter readings" was explained and recommended by Mr. Hegarty and Mr. Thorpe, who have been using that system in the Little Rock Railway & Electrical Company for the past three years.

The concluding business of Wednesday was the reports of the executive and legislative committees and the president's address. Mr. D. A. Hegarty, of Little Rock, being chairman of both committees, presented a combined report explaining the reasons for the failure to organize a tri-state association with Mississippi and Tennessee. Since the State Legislature has been in session several months of this year, the legislative committee has been on the alert watching the progress of all bills aimed at corporations and has assisted in developing sentiment in the Legislature opposed to freak corporation laws. By showing the unfair points of several proposed bills these bills have been tabled or lost. To Mr. Hegarty the highest praise is due for his watchfulness over any proposed legislation affecting the corporate interests of the State.

In his address President Fowles told of the present very healthy condition of the association and urged all the members to make still greater efforts for the advancement of its interests.

On Thursday morning Mr. M. Q. Woodward, new-business manager of the Pine Bluff Corporation, presented a very able paper on "New Business." The necessity for an active new-business policy he showed from two viewpoints. First, the owners of a plant go to a large expense to install and operate that plant, and then, in many cases, do not attempt to secure all the business that is to be had in their territory. This he considers a neglect of duty by the owners. Second, the public in most places grants a monopoly to the plant and the public can be best served only when all are satisfied users of the plant's product.

The best adjuncts of a new-business department are a complete knowledge of the proposed customer's need and unfailing tact in approaching him. Definite, one-thing-at-a-time advertising is a great help.

Finally, the rates must be such as to make the use of the service economical. The paper was discussed by Messrs. Fletcher, Hegarty, Fowles, Wood, Leake, Brown and Riedel. Mr. Fowles described his company's success in motor-service business, it now having 780 hp connected and the load-curve of the plant showing its peak in the daytime.

The value of sign business, auto-charging, flatirons and all heating devices was discussed at length.

Mr. D. A. Hegarty, general manager of the Little Rock Railway & Electrical Company, then read a very complete paper on "Roadbed Construction," describing the most up-to-date methods. He called attention to the unwisdom in the conditions forced upon some railways by their franchises requiring the use of special rail shapes. He thinks that the interests of the public are amply safeguarded by the competent engineers in charge of railway work.

Messrs. Hardin, Wood and Griffith discussed the merits of creosoted pine and steel ties, soldered rail bonds, ground return cable laid in concrete, and the different forms of pavement to be used between rails.

On Thursday afternoon Mr. F. C. Bragg, manager of the Electric Construction Company, Little Rock, Ark., read a paper on the "Relations Between Contractors and Central Stations." The author called attention to the fact that the greatest prosperity can come to a central station only when it has the good will of all its customers. Hearty co-operation between contractors and the central station can do very much toward maintaining and creating this friendly feeling of the public. The discussion following the paper was joined in by most of the central-station men, and all expressed the desire to help every contractor who is treating the public fairly and to do all they can to eliminate the "curbstoner." They recommend the passage in all cities of ordinances requiring the examination, bonding and licensing of all persons doing electrical work.

Next on the program was to be a paper on "Municipal Plants of Arkansas," by Mr. W. H. Walkup, of Batesville. Mr. Walkup reported that for some reason he received only three replies to the letters sent to sixteen municipal plants and two of these three had been keeping complete records for too short a period to be of value at this time. The replies received came from cities which are under commission form of government instead of aldermanic. The convention thanked Mr. Walkup for his efforts and requested him to cover the same topic next year.

The afternoon program was closed by a paper on "Feeder Regulators," by Mr. C. E. Allen, of the Westinghouse Electrical & Manufacturing Company, Pittsburgh. The paper was devoted to a description of the single-phase induction regulator and its relay and auxiliary devices. Numerous questions were asked after its reading.

President-Elect J. M. Hewitt.

The Friday morning session was opened with a paper on "General Accounting, Public Utility Corporations," by Mr. W. J. Thorpe, auditor Little Rock Railway & Electrical Company. This was a very complete description of the excellent accounting system in use in Little Rock. By this system the exact condition of revenues and expenses is shown at the end of each month, interest, taxes, depreciation, etc., being applied monthly. Discussion by Messrs. Fowles, Wood and Hegarty followed,

who recommended the accurate keeping of storeroom accounts and "scrap" sales. The "Thatcher" cylindrical slide rule was said to be of great help in arriving at unit costs for the monthly statement.

Following the discussion of the above paper the association went into executive session and considered all business before it. A vote of thanks was extended to all the authors of papers, to the Marion Hotel and to the Little Rock Railway & Electrical Company for the free transportation extended to delegates.

The secretary was unable to make a report on account of incomplete records.

The following officers were elected for the ensuing year: President, J. M. Hewitt, of Mariana; vice-presidents, Messrs. W. L. Wood, Jr., Texarkana; J. W. McLendon, Fayetteville, and W. C. Maguire, Arkadelphia; secretary, Mr. W. J. Thorpe, Little Rock; treasurer, Mr. Ed. Hardin, Hot Springs; executive committee, Mr. D. A. Hegarty, chairman, and Messrs. S. A. Stearns, A. E. Main, C. J. Griffith, W. H. Walkup, W. C. Maguire, B. C. Fowles and Ed. Hardin.

The question of a proper salary for the secretary was referred to the executive committee. Mr. D. A. Hegarty was appointed chairman of the legislative committee, with power to choose his assistants.

The entertainment features of the convention were most enjoyable. On Wednesday night there was a theater party at the Majestic Theater; on Thursday night at the New Capitol Hotel a banquet for the men, and at the Marion Hotel at the same time one for the ladies of the convention. At the men's banquet, in addition to the many toasts by the members, Toastmaster Hegarty called upon Mr. J. B. Parker, editor of the Fort Smith *Southwest American*, and Mr. Arthur Turner, State Senator from Jonesboro. Both of these gentlemen commented on the more kindly attitude of the public to the public-service corporations and predicted better times to come as a result of the upright management of corporations.

For both these banquets the association thanked the Class B members who so bounteously provided it.

The afternoons were made pleasant for the ladies with numerous automobile rides.

The convention closed on Friday afternoon, May 5, with a visit to the power house of the Little Rock Railway & Electrical Company and the Little Rock municipal plant.

Closing Sessions of A. I. E. E. Pacific Coast Meeting.

Our issue for May 4 contained an outline of the Pacific Coast meeting of the American Institute of Electrical Engineers at Los Angeles from April 25 to 28, together with abstracts of the papers and discussions at the opening sessions. Below are given abstracts of the papers and discussions at the remaining sessions.

TELEPHONY.

Among the papers presented three dealt with the general subject of telephony, as follows: "New Automatic Telephone Equipment," by Mr. Charles S. Winton, of Chicago; "The Semi-Automatic Method of Handling Telephone Traffic," by Mr. Edward E. Clement, of Washington, D. C., and "Some Recent Developments in Railway Telephone Systems," by Mr. Gregory Brown, of New York.

The paper by Mr. Winton contained an outline of automatic telephone apparatus of interest chiefly from a historical viewpoint, together with a description of equipments that have recently been developed and will, in all probability, be put in practical use in the near future.

Mr. Clement discussed the limitation and waste necessarily involved in manually operated exchange systems, outlined the characteristic features and limitations of automatic methods and explained the principles involved in the automanual system, and the manner in which they are applied to avoid waste and secure increased economy and efficacy.

Mr. Brown showed that although the telephone has been in use on railroad divisions for less than four years, it has been found to have a great many advantages over the telegraph which the railroads were quick to appreciate. He said that at the present time about 37,000 miles of road are equipped with the telephone, and there have been no instances thus far in which accident of any kind can be traced to the use of the telephone for railroad work.

Discussion.

It had been arranged that Mr. S. G. McMeen, of the telegraphy and telephony committee, would preside, but being unable to serve, by reason of illness, he was most satisfactorily represented by Mr. Kempster B. Miller. The telephone papers by Messrs. Winston and Clement were jointly discussed. Mr. Leo Keller quoted extensively from letters received from a foreign electrical engineer, and said that if a semi-automatic led to a full automatic system he believed it to be a step in the right direction, and that a flat rate was suitable for the automatic, and the measured service for the manual system. Chairman Miller thought that the attitude of the public is the determining factor. Either system now in extensive use, whether automatic or manual, seems to meet the requirements, and it is good service that the subscribers want. Mr. A. H. Griswold believed that it is the most reliable system that is wanted, not the most rapid. Mr. Newell called attention to the universality of numerals as written in nearly all languages and the difference in pronunciation of the names of figures. This leads to confusion in certain cosmopolitan cities, and consequently the dial of the automatic is better adapted for service in such localities. Mr. Keller said that the automatic is for that reason preferred in Havana, and also by the Chinese in San Francisco. Mr. A. H. Babcock, speaking from his own experience, pointed out the difficulty of repeating through the central exchange certain call numbers which were correctly received and transmitted by the operator in a private branch but were subsequently misunderstood.

Mr. R. W. Pope thought that the more satisfactory service given through the private branch exchange had not been considered in discussing the comparative merits of the systems. For four years his connections had been made through a private branch exchange, and it appeared to him the service was far more satisfactory, although possibly not as quick as when working directly with central.

Chairman Miller reminded the speakers that in the discussion of the merits of the different systems an advance had been made in that whichever system might be advocated there appeared to be a general agreement that all of them were giving good service.

In discussing Mr. Brown's paper Mr. L. B. Cramer spoke of the successful use of the telephone upon the electric railway through the Willamette Valley, where, however, some trouble had been apparently caused by interference with the circuits by telegraph operators, due to the impression that the introduction of telephones might make their services unnecessary.

Mr. Pope expressed the opinion that this interference was more mischievous than malicious, many of the operators being quite young and failing to appreciate the responsibility of their duties. It was his experience that the simplicity of the Morse system and its applicability to the railroad service, especially train dispatching, is not fully appreciated by those who are not thoroughly trained in reading by sound with the Morse code. At the minor way stations, where the agent is a practical operator, he can keep an ear on what is doing on the wire without in all cases dropping his other work to the same extent as when answering and listening to the telephone. The transmission of written messages by Morse is more accurate and convenient with the telegraph. The whole question is to be settled by actual experience, as the telephone has certain advantages which might or might not outweigh its disadvantages.

Chairman Miller said that dispatchers object to the necessity of wearing a harness in order to keep the telephone and transmitter available and their hands free for writing. The convenience of the telegraph for recording communications and its accuracy must be admitted.

Prof. C. L. Cory said that the comparative merits of systems

must be viewed from two standpoints—that of the user or subscriber, and that of the engineer or inventor who had devoted many years to the development and perfection of the various systems. Perfect communication than cannot be interfered with is the ordinary face-to-face conversation, and the more closely this can be realized in completing the artificial connection between two individuals separated by a considerable distance, and the more perfect the transmission of the ensuing conversation, the better will be the whole telephone service. To attain this perfection is the object of the engineer, and all improvements introduced should have this end in view.

Mr. S. J. Lisberger stated that in the distribution system of the Pacific Gas & Electric Company, in San Francisco, the officers had been confronted with the problem of quick communication between the main station and nine substations. Originally a central exchange switchboard had been installed, but calls were sometimes congested, as was especially the case during the fire. It appeared necessary to introduce either an intercommunicating or an automatic system. Mr. McMeen worked out the problem, using an automatic set at each substation operating over the wires of the Home Telephone Company. A call may now be completed in three seconds, and by the use of a magneto ringer all substations may be summoned for a general call. This plan has given entire satisfaction.

Mr. Winston, replying to an inquiry as to handling a "reverting call" by the automatic system, explained that this is a call for a subscriber on the line where the call originated. No solution of this problem has been found. No system, either manual or automatic, is ideal. Conflicting calls will interfere with each other. It does not appear to him that a combination of the semi-automatic and the full automatic is feasible. After the connection is established with the semi-automatic, the operator is disconnected. In re-establishing a connection the subscriber may or may not reach the same operator. The original cost of automatic apparatus, and the cost of maintenance, are prohibitive for small plants. The quality of service is not the final test, but rather the financial result—the "almighty dollar."

Mr. Clement, in closing the discussion on his paper, said that he believed that the semi-automatic would be reached in the future. The subscriber after giving the required number hears the impulses and the ringing, and knows that attention is being given to his call. The operator's duties are confined to setting up the numbers, and she is not overworked. The operator does not know who is calling. The recall of the same operator is neither necessary nor advisable. He does not consider the percentage of foreign subscribers sufficiently large to have much weight in favor of the full automatic. The semi-automatic will do anything that the automatic can do and anything that the manual can do.

Mr. Gregory Brown, in closing the discussion on his paper, said that a loud speaker has been developed for use with the block signal system, and also for dispatchers. It has been found satisfactory, excepting that its articulation is inferior. There is no doubt that the telephone has proved of value in railway service. In sending out the orders the dispatcher speaks the words no faster than he can write them down himself, and consequently the person receiving can also write them down. Then as each word is repeated back it is underscored as many times as there are stations to which the order was originally sent.

HIGH-TENSION TRANSMISSION AND UTILIZATION.

The afternoon session on Thursday was presided over by Mr. Ralph D. Mershon, of the high-tension transmission committee, the first paper presented being one by Mr. M. T. Crawford on "Continuity of Service in Transmission Systems." A paper by Mr. E. J. Barry, entitled "Electricity in the Lumber Industry," was also presented. Abstracts of these papers appeared in our issue for May 4. At the final session on Thursday evening Prof. Harris J. Ryan presented a paper on "A Power Diagram for High-Tension Circuits."

Professor Ryan described the methods developed by him for using the cathode-ray pointer to trace an energy cycle. The cathode rays produced in a Braun-Ryan tube are deflected electrostatically by means of the changing charge on "quadrants" surrounding the ray stream in a radial direction. The pressure of the high-tension circuit applied to the quadrants causes a proportional displacement of the ray-pointer in one axis; the pressure drop between the terminals of a condenser in series with the high-tension circuit is applied to the other pair of quadrants and gives the ray-pointer a quadrature velocity proportional to the current. The ray-pointer is thus made to trace a diagram that incloses an area proportional to the emf-current-time product. Alternating current will produce a closed diagram or "card" having an area which is proportional to the energy of the circuit delivered per cycle. At constant frequency, therefore, the card area measures the power applied in the circuit. The form of the card tells of many things besides the amount of power just as the steam-engine indicator card does in steam engineering.

The pressure and current ranges of the instrument are controlled by values of the capacities of the condensers employed. The capacities of the operating condensers may be varied indefinitely so that the working range of the instrument may be varied also indefinitely. The instrument has been used to measure the dielectric loss that occurred in a one-quart sample of insulating oil, caused by moisture or other impurities. The values encountered were 0.03 watt at 9000 volts; this was the smallest high-tension power measured in the trying-out tests. The highest power measured was a corona loss of 750 watts that occurred at 130,000 effective volts on a high-tension laboratory line.

Discussion.

In discussing Mr. Crawford's paper Mr. P. M. Downing said that he had experienced but few cases of poles burning. He had never installed electrolytic arresters on high-voltage lines. Very little trouble has been caused by lightning in central California. During the past winter wires were severed in two instances, but no further damage was caused. A reverse power relay for low voltages, especially in net works, is much needed. The manufacturers have produced an instrument which is inoperative when the voltage drops below a certain point. He has used an induction indicator, which shows on which circuit the trouble is.

Mr. E. F. Scattergood thought the objections to automatic devices were greater than the advantages, as when one goes out several others go with it, making a serious addition to the original trouble and resulting in an interference with the load. It is better to risk the transformers than to have the circuit-breakers go out, thus perhaps disturbing the entire system. The discussion was continued by Messrs. C. O. Poole and Ralph Bennett.

Mr. R. Bennett, in the discussion of Mr. Barry's paper, said that there is a great opportunity for labor-saving devices in the lumber industry. Modern mills have two engines, one in front and one in rear, and operate a monorail trace made of a single I-beam elevated 25 ft., by which lumber can be landed at various parts of the yard, thus reducing the cost of storage.

In reply to inquiries as to the availability of the power diagram instrument in portable form for practical use, Professor Ryan said that he had been assured by a manufacturer that he would undertake to place it on the market, and that in its present experimental form it is sufficiently portable.

GENERAL CONVENTION NOTES.

Before the adjournment of the meeting resolutions expressing the thanks of the Institute to members of the local committee for their courtesies and hospitality were adopted, as reported by a committee consisting of S. J. Lisberger, of San Francisco; L. B. Cramer, of Portland, Ore.; M. T. Crawford, of Seattle, and J. J. Frank, of Pittsfield.

All the sessions of the meetings were held in the Hotel Alexandria, and the entire arrangements as planned by the local committee were most successfully carried out to the entire satisfaction of all.

The social features and technical visits were thoroughly appreciated. They were so arranged as to be carried out without

interference with the various sessions. Special entertainment was provided for the ladies during the sessions. On Tuesday evening the members made a trip to Redondo Beach over the Los Angeles Pacific Electric Railway, and after an inspection of the Redondo oil-fuel power plant were regaled with a bounteous Pacific shore dinner, returning to the city by another route. On Wednesday night there was an excursion up Mount Lowe, including a dinner at the unique Alpine Tavern. On the return trip a fine searchlight view over the valley was enjoyed from the station at Echo Park. Friday was devoted to a most enjoyable trip over the Southern Pacific Railway, a distance of 70 miles, into the orange district. Teams and automobiles met the train and conveyed the party numbering 225 to the Santa Ana and Mill Creek power houses of the Southern California Edison Company. A luncheon was served near the last power house visited. Returning via Redlands by train to Riverside, dinner was served at the Glenwood Mission Inn, and after an organ recital in the cloister by Professor McClelland, of Salt Lake City, an informal farewell meeting was held. A few of the party remained over for a visit to Santa Catalina Island on Saturday.

Electric-Vehicle Publicity.

At a meeting of the Electric Vehicle Club of Boston on May 3 Mr. C. Brewer Smith, as advertising expert, stated that within a few days he would call upon the various dealers in the interest of a centralized campaign of publicity, and said that a prominent Boston newspaper publisher had promised to devote more attention to the electric vehicle in the future as a result of the concentrated advertising to be displayed. A miniature sign was exhibited as a result of a conference with a prominent billboard house, calling attention to the advantages of commercial and pleasure vehicles of the electric type. As stated in a previous issue, several signs will be installed in and near Boston for this service, with free energy and maintenance by the Edison company. Mr. Frank J. Stone, Boston, emphasized the desirability of placing the name of the electric-vehicle manufacturer on the battery box or on the running boards of pleasure vehicles, if the owners permit. He felt that the advertising of the names of gasoline-car makers on the radiators should be offset by effective displays in electric machines. Mr. Day Baker said that his company almost always received permission to print the words "Electric Truck" or "Electric Wagon" on the battery box. The average man in the street does not distinguish between gasoline and electric vehicles, and the use of the above form of publicity is a distinct benefit to the industry. Mr. Baker also emphasized the vital importance of additional charging stations in eastern Massachusetts, and said that unless owners of electric trucks can be assured of securing a boosting charge of an hour or so at certain points, the gasoline machine is bound to drive the electric vehicle out of certain fields. In one case this had actually happened, although it was shown that the owner had failed to guarantee the central station a definite weekly business.

Col. E. W. M. Bailey, Andover, Mass., advocated the preparation of a card index of charging points, to be filed with the secretary of the club. He cited various unhappy experiences on the road through the inaccuracy of published lists of charging stations, and pointed out that unless such information is reliable it is likely to do the industry genuine harm. Mr. W. E. Eldredge, Boston, for the committee on prospective customers, said that if the proposed letter from the Boston Edison Company is sent to prospective customers on behalf of electric vehicles, its influence is certain to be more effective than correspondence from interested dealers. Mr. Mansfield said that the Edison company will maintain a list of prospective customers for the benefit of the club, the list being assembled from inquiries which are constantly being received by the company.

A committee was designated to consider the best methods of launching a parade of electric trucks in connection with the workhorse parade, which is held on May 30, yearly, at Boston. Already owners of about fifty machines have signified their willingness to enter, and it is expected that the contrasting of the most modern trucks with the horse-drawn wagons will prove educational to the public in the interests of electricity. Another committee was appointed to investigate the desirability of a floral parade of electric pleasure vehicles in June. Other recommendations were one for larger signs indicating the location of charging stations, which was referred to the New England section of the Electric Vehicle Association of America, and one asking dealers to notify the Edison company regularly of their sales, so that the latter may be in full possession of the most convincing data of progress.

Rate Situation in St. Louis.

Mr. Alten S. Miller, president of the Union Electric Light & Power Company, St. Louis, Mo., has made a public statement in reference to the new schedule of rates prescribed by the city. Although the new rates are not satisfactory, the company is anxious to reach a compromise agreement and will submit a new schedule and ask the Public Service Commission to review the rates. Mr. Miller added that the company is willing to lower the rate for residence consumers.

In reference to the situation the directors of the company state that they have asked the attorneys to request a review of the new rate ordinance, in accordance with the law under which the Public Service Commission was created. Application for review in such a case must be filed within twenty days of the approval of the ordinance. The directors believe that certain provisions in the ordinance are against the interest both of the company and its customers, and that the company is therefore obligated to ask for court review. Reduction of the residence rates should be made in such a way as to stimulate business and bear some relation to the cost of service if it is to result in benefit to the community as a whole. If satisfactory arrangements to this end can be made with the city, the company is willing to put price reductions into effect within two or three months.

The statement of the directors says, furthermore, that they regret the necessity of delay in the reduction of rates, and the putting off of the date on which the municipal regulation becomes effective, but that this delay results necessarily from the inability of the company to accept the ordinance as it was passed. The method of reduction of the maximum rate and several of the provisions embodied for regulation make the acceptance of the ordinance impossible. When two parties are anxious to agree there should be some solution for small differences. The directors believe that the problems may be quickly solved and in a manner satisfactory to the municipal authorities.

Hearing on Proposed Dam Across the St. Lawrence.

The application of the Canadian Light, Heat & Power Company for permission to construct a dam across the St. Lawrence River, mention of which was made in these columns last week, was considered by Sir Wilfrid Laurier and the Minister of Public Works at Ottawa. The company wishes to build a dam across the St. Lawrence from Coteau du Lac to Clark's Island, both points being in Canadian territory. It is proposed to develop 62,000 hp from a point at the head of the Beauharnois Canal, just above the Cedar Rapids, the water being returned to the river at St. Timothy, just below the Cedar Rapids. For the navigation of boats the company proposes to build a sluiceway to give sufficient depth to pass the rapids. The company's application was opposed by representatives of the Cedar Rapids Company, the Beauharnois Power Company, the Richelieu & Ontario Navigation Company and the Dominion Marine Association. The navigation company maintained that the current

through the sluiceway would be so swift as to preclude navigation. Both power companies claim that their power would be seriously affected if the dam were built. At the suggestion of the government engineer, it is proposed to refer the matter of damming the St. Lawrence to a commission of experts.

Ohio Legislative News.

The 200 amendments made to the Public Utilities Bill by the sub-committee have been adopted in their entirety by the Ohio Senate. The most important amendments to this bill were outlined in these columns last week, and in the debate on the Senate floor the greatest emphasis was placed upon those features which permit the formulation of rates upon the basis of capital instead of physical value; restraint in forming new companies and granting new franchises without a certificate of public necessity from the Public Utilities Commission, and the taking away from municipalities of the right of home rule in franchise matters.

A bill has been introduced in the Senate giving city councils the right to examine the books of electric light, gas and water companies in order to secure information upon which to base rates for service to be put into new franchises. A company may be required to submit a statement showing detailed facts on which to base the rate; cost of all construction work; amount expended in permanent improvements; present value of plant, exclusive of franchises or good-will; present as compared with original cost of construction; par value and market value of stocks and bonds; yearly expenses of supplying its product; gross receipts; depreciation, etc. The bill was prepared by Mayor George Marshall of Columbus, in order to open the way for securing information from the natural-gas company, which is seeking a new grant.

Canadian Hydroelectric Commission News.

After a conference with the chairman of the Hydroelectric Commission of Ontario the city representatives of Guelph, Ont., have been informed that the cost of energy at Guelph will be $25 per hp-year for the next year and a half, or until December, 1912. After that the price will be reduced gradually until it reaches $20 per hp-year. The city commission will not be allowed to install motors free of charge.

Mr. H. L. Drayton, K.C., corporation counsel of Toronto, has been appointed a member of the Civic Commission to manage the hydroelectric business. At a meeting of the newly appointed commission Mr. P. W. Ellis was chosen chairman. The question of rates was not taken up pending the report of the commission's electrical engineers and business manager.

Massachusetts Legislative News.

The committee on public lighting has sent in an adverse report on House Bill 1131, which provides that all electricity furnished by any corporation or association to any customer shall be separately metered and charged for per kw-hour at a single uniform rate for lighting to all customers without regard to the quantities furnished to them respectively, and the House has sustained the action of the committee. The committee on street railways has voted leave to withdraw House Bill 1369, which provides an elaborate method of establishing either the state or city ownership of street railways. During the present session, as in preceding years, the Legislature has persistently refused to interfere with the regulation of rates of public-utility companies in the belief that adequate supervision of these matters is already exercised by the various state commissions, and unless the temper and composition of the General Court changes radically in the future the efforts of various irresponsible elements to undermine the regulating practices of the State will be doomed to failure from the start. An adverse report has been sent in by the committee on street railways upon Senate Bill 260, which requires street railway companies to provide special service for workingmen and women at reduced rates of fare during certain hours of the morning and evening. Only five bills remain to be reported upon by the committee on public lighting, these covering questions of dividends, surplus, meter charges and rate discrimination.

Maryland Commission News.

The Maryland Public Service Commission handed down a decision in the case of the Allied Committees of the Suburbs of Baltimore growing out of the commission's order directing the withdrawal by the United Railways of the residents' books issued on the Catonsville, Govanstown and Emory Grove lines. In the opinion handed down the commission takes the view that the form of the ticket heretofore issued was unduly discriminatory, as it is not open to purchase by all persons who may desire to use the railway, but it is only open to residents, and it, therefore, refuses to order the restoration of the tickets. The commission recommends the issuance of some form of commutation tickets open to the general public.

The case of the Belvedere Hotel Company against the Western Union & Postal Telegraph Companies will probably be decided by the Public Service Commission in a few days. Mr. George Blakiston, president of the hotel company, offered both companies offices in the hotel, but these offices were not satisfactory to the companies and they removed their instruments. Mr. Blakiston appealed to the Public Service Commission, asking it to compel the restoration of the telegraph offices in the hotel, basing his petition on the ground that it is a public necessity. He claimed that in the course of last year there had been some 83,000 registered guests who had spent one or more nights at the hotel, and he thinks that the telegraph offices ought to be re-established as a matter of public convenience.

Wisconsin Commission News.

The Marshfield Municipal Water, Electric Light & Power Plant has requested the commission to investigate its electric rate situation and to recommend a rate schedule which will eliminate the inequalities and discriminatory features of the present schedule. The physical valuation of the property will be determined by the commission and will serve as the basis for an informal investigation and report to be made in the near future.

The Board of Public Works of Waupun has filed certain amendments to its water and light rate schedules and has asked for their approval by the commission. By this amendment the board seeks to discontinue the free use of water and electricity for libraries, schools, churches and other public buildings. The amendment provides further that when service shall be discontinued for any consumer, upon his request, or for any other reason, a charge of $1 shall be made for a reconnection. Permission was also requested by the board for authority to discontinue all flat rates and to install meters in all premises and charge a meter rate. The commission notified the board that the desired changes would undoubtedly produce a more equitable rate schedule, but that technically these changes could not be authorized, since the change would involve an increase in rates. It was suggested that if adjustments satisfactory to the consumers could not be made it would be advisable for the board to make a formal application for a readjustment of rates.

The Chippewa Valley Railway, Light & Power Company has filed an amendment reducing its energy rate for motor service in Eau Claire. The amendment grants a reduction to consumers using 20 hp or more when the readiness-to-serve charge

plus the charge for energy exceeds 4 cents per kw-hour consumed. The readiness-to-serve charge will then be canceled and the total bill computed on the 4-cent basis.

The Madison Gas & Electric Company, having been compelled to lay considerable underground conduit by reason of paving work ordered by the city in certain business streets, has filed an amendment to its present rate schedule stating that the company will install its conduits and cables from the main ducts to the curb free of charge to the consumer, provided the consumer or property owner signs a contract for the installation of the conduit and cables from the curb to the terminals inside the building. The cost schedule for underground service is as follows:

Conduit: One duct—First 12 ft., $1 per foot; excess, $0.50 per foot. Two duct—First 12 ft., $1.15 per foot; excess, $0.60 per foot.

Cable: Three-conductor, lead-covered cable, installed, 50 cents per foot, provided the connected load does not exceed 10 kw.

Inside iron conduit will be installed for 30 cents per foot. A flat charge of $6 will be made to cover the cost of all extra equipment necessary, including a suitable service switch, terminal board, etc.

Florida Commission News.

The Florida Senate has passed without a dissenting vote the McCreary bill to extend and enlarge the powers of the Railroad Commissioners of the State so as to give them the exclusive power and authority within the State to regulate charges and service of all persons, firms or corporations carrying on a telephone business within the State of Florida and for other purposes.

AMERICAN ELECTRICAL ENGINEERS—XXXII.

H. Weichsel.

Hans Weichsel was born at Frankfort-on-the-Main, Germany, Feb. 27, 1878, where he received his primary and high-school education. Realizing the great benefit of practical training, at the early age of fourteen he secured a position in a factory, where he worked during vacations and holidays, thus becoming a very proficient mechanic by the time he had finished his high-school work.

After graduating from the high school he entered the Technical University of Darmstadt, where he devoted all of his time to electrical and mechanical engineering. At the end of the second year he was appointed assistant professor in this department, which position he retained for one year. Again feeling the need of practical experience he left the university to accept a position with the Maschinenfabrik, Magdeburg, where he acquired an extended knowledge of steam-engine work, and especially of flywheel governors, and took an active part in the design of a large vertical triple-cylinder engine. Returning to the university, he took the degree of E.E. in 1900, passing each examination with highest honors.

Upon graduation he accepted a position in the engineering department of the Helios Company, Cologne, where he was brought into close contact with the single-phase commutator motor, which this company was exploiting actively at that time. This led to a concentration of interest on the design of single-phase commutator and induction motors, which branch was adopted as a specialty. Later on he was engaged by the Siemens & Halske Company, of Berlin, and while with this concern became familiar with the manufacture of electric vehicles and electric-railway equipment. The branch of alternating-current motors, however, appealed to him so strongly that soon afterward he returned to that line of work. From 1902 to 1904 Mr. Weichsel was engineer in charge of the Magneta Works, of Zurich, Switzerland, and while there made a special study of the phenomena of "current impulses," in connection therewith inventing forms of ballistic dynamometer and wattmeter for the measurement of the power, effective current and effective voltage of a "current impulse."

In 1904 Mr. Weichsel came to this country, partly on a pleasure trip and partly to investigate American electrical engineering practice and designing methods. Becoming much interested in what he saw, he accepted a position with a consulting engineer in New York City, thereby enabling himself to study more completely details of American practice. Later he decided to remain in the United States, and in order to resume

H. Weichsel.

his work as an electrical engineer took a position with the Westinghouse Electric & Manufacturing Company, with which he remained until 1906. During this period he became familiar with the American methods of designing alternating-current machinery. At the end of that year he joined the engineering staff of the Wagner Electric Manufacturing Company, of St. Louis, with which he is now connected as the head of the department of motor and generator design. Mr. Weichsel has designed for this company a complete line of polyphase induction motors and alternating-current generators and has also enlarged the line of well-known Wagner single-phase induction and repulsion motors. Concurrently a complete study has been made of the theory and practical method of calculation of these various types of machines.

Patents have been granted to Mr. Weichsel for alternating-current commutator motors, a starting device for motors and a magneto inductor without movable contacts. He has always taken much interest in literary work and has been for many years a regular contributor to the *Annalen der Physik*. He has also contributed articles on the subject of "The Ballistic Dynamometer and Wattmeter" to the Vienna *Zeitschrift für Elektrotechnik* and on "Single-Phase Series Motors as a Universal Choke-Coil" to the *Elektrotechnische Zeitschrift*, of Berlin. Recently he published a complete treatise on "Winding Coefficients of Single-Phase Motors" in an American technical journal. His latest contribution to American technical literature was an article on "The Losses in Single-Phase Rotors," which appeared in these columns April 20 and 27, 1911.

Mr. Weichsel is an associate members of the American Institute of Electrical Engineers, a member of the National Electric Light Association, the Verbund Deutscher Elektrotechniker, the Academy of Science, the Engineers' Club and the League of Electrical Interests of St. Louis.

CURRENT NEWS AND NOTES.

Customers' Repairs.—In a paper recently read before the Commonwealth Edison Branch of the N. E. L. A. in Chicago the interesting fact was brought out that nine telephone lines are needed to take care of the incoming calls of the customers' repair department of the Commonwealth Edison Company. The average cost of making these repairs is 32 cents.

Boston Edison N. E. L. A. Section Excursion.—The Boston Edison Section of the National Electric Light Association participated in an excursion on Saturday afternoon, May 6, to the United States Arsenal at Watertown, Mass., where the process of steel making, heavy testing methods and other features of interest were exhibited by courtesy of the Commandant.

Central-Station Activity in Ohio.—Mr. D. L. Gaskill, president of the Greenville (Ohio) Electric Light & Power Company and secretary of the Ohio Electric Light Association and the National District Heating Association, at a meeting of the Electric Club of Chicago on May 3, at which he was a guest of the club, said that last year was the most successful in the history of the central stations of Ohio. Marked improvements are in prospect, for many stations are nearing their maximum rating in output, and it will be necessary soon to tear down and build greater. In the field of electric heating, particularly the introduction of a practicable electric kitchen range, the outlook is especially promising.

Large Hotel Telephone Installation.—In the McAlpin Hotel, which is now being built at Broadway and Thirty-fourth Street, New York, the telephone installation will consist of 100 trunk lines and 1800 stations. It is estimated that there will be transmitted from these stations 500,000 messages annually at a service cost of $28,334. The main telephone switchboard will contain sixteen regular operating positions. There will be three sub-switchboards, as follows: One two-position switchboard with seventeen booths in the main corridor; one with sixteen stations in the engineering department, and one with twelve extensions for the use of the office force. There will also be a complete telautographic equipment of sixteen instruments.

Special Meeting of Boston Section, A. I. E. E.—A special meeting of the Boston Section of the American Institute of Electrical Engineers was held at the Massachusetts Institute of Technology on May 5, Chairman J. F. Vaughan presiding. The electrical engineering laboratories of the Institute were open to visitors in the afternoon and at 6 o'clock dinner was served at the Technology Union. At 8 o'clock a paper was read by Prof. Harold Pender on "Transmission Line Graphics," and several ingenious methods developed by the author in solving line problems were discussed. Following the reading of the paper a discussion took place, Dr. A. E. Kennelly and Mr. N. J. Neall being among the speakers. About eighty persons attended the meeting.

New York Companies Section, N. E. L. A.—Mr. Nikola Tesla will address the members of the New York Companies Section of the National Electric Light Association at the monthly meeting to be held on May 15 in the Engineering Societies Building. Following his talk there will be a series of papers on the following subjects: *Securing Business on the Instalment Plan; Its Advantages and Disadvantages*, by Mr. A. A. Pope; *Value of the Electrical Sign as a Business Getter*, by Mr. Jesse Richards; *Value of the Show Window as an Advertising Factor*, by Mr. Joseph F. Becker; *How Best to School Our Commercial Men*, by Mr. F. C. Henderschott. After the business meeting there will be a vaudeville entertainment, and refreshments will be served.

Supply Men at Del Monte.—The convention of the Electrical Supply Jobbers' Association at Del Monte, Cal., on April 25, 26 and 27 gave an opportunity for a most enjoyable visit to the Pacific Coast by many members and friends of the association, a number of whom were accompanied by their wives. The California members were most hospitable and provided a program of entertainment that was greatly appreciated. There were no formal papers read, the discussions at the sessions of the convention being devoted to the present business situation. Between sessions there were games of golf, tennis, trap shooting—one source of information gives this as "crap shooting," but this is evidently a mistake—billiards, etc., and prizes were awarded to the winners.

Maintenance of Service.—In a paper recently read before the Commonwealth Edison Branch of the National Electric Light Association in Chicago Mr. W. L. Abbott, chief operating engineer of the Commonwealth Edison Company, said that maintenance of service is the first commandment of the company. Not once in sixteen years has the pressure been off the mains of the central-station company in the central business district of Chicago, and only once in that time has it been low enough to affect the service seriously. However, constant "troubles" are encountered in maintaining the service, particularly in outlying districts, and Mr. Abbott described the emergency methods used in meeting these accidents. In doing so he gave a general perspective view of the whole operating department.

New York's Rejection of Federal Dam Offer.—On the ground that it is now the policy of the State to conserve and develop for its own use or under its control all its water rights, Governor Dix of New York has sent to Washington notice that the State cannot accept the federal government's agreement to build the new dam at Troy and to make other improvements in the Hudson River between Waterford and Troy, for which the government had appropriated about $5,000,000. The new dam was to be of concrete, with locks large enough to accommodate the traffic of the barge canal, which enters the river about 2 miles above the proposed site for the dam. As a result of the action of the State authorities, it was said the dam might now be built by the State without aid from Washington. The federal government's agreement and appropriation were made on condition that the State cancel the water-power contracts with the Troy Hydraulic Company at the present dam, and the government insists on controlling the power rights in connection with the new dam. The improvement planned by the federal government is actively favored by the Chamber of Commerce and other interests in Troy, and much opposition to the action of the State officials has developed.

Convention of the Ohio Society of Mechanical, Electrical and Steam Engineers.—The twenty-third meeting of the Ohio Society of Mechanical, Electrical and Steam Engineers will be held in the Elks' Club Auditorium, Youngstown, Ohio, May 18-19. The program embraces the following papers: *Flue-Gas Analysis*, by Mr. Joseph W. Hayes, of the Combustion Appliance Company, Chicago, Ill.; *The Engineering Features of the Columbus Garbage Reduction Plant*, by Mr. I. F. Osborn, Columbus, Ohio; *Industrial Motor Control*, by Mr. D. Martignone, of the General Electric Company, Cleveland, Ohio; *Load Regulation by Means of Storage Batteries*, by Mr. J. H. Tracy, Electric Storage Battery Company, Philadelphia,, Pa.; *General Comments Concerning Hydroelectric Development in the Central West*, by Mr. Paul M. Lincoln, Westinghouse Electric & Manufacturing Company, Pittsburgh, Pa.; *Centrifugal Blowers*, by Dr. Lowenstein, of the General Electric Company, Schenectady, N. Y. Inspection trips will also be made to the Youngstown Sheet & Tube Company's works, Ohio works of the United States Steel Corporation, General Fire-Proofing Company, Trussed Concrete Steel Company, Republic Rubber Company and other interesting works in the vicinity of Youngstown. Mr. O. F. Rabbe, of Toledo, Ohio, is president of the organization, and Mr. F. E. Sanborn, of the Ohio State University, Columbus, Ohio, is secretary and treasurer.

New York Section I. E. S.—At a meeting of the New York Section of the Illuminating Engineering Society to be held in the Engineering Societies Building on May 11 Dr. R. S. Woodworth, professor of psychology, Columbia University, will present a paper entitled "Psychology of Light."

Railway Telegraph Superintendents' Convention.—The annual convention of the Association of Railway Telegraph Superintendents will be held in the Hotel Brunswick, Boston, on June 26 to 30. Mr. P. W. Drew, 114 West Adams Street, Chicago, is secretary of the association.

Meeting Baltimore Section, A. I. E. E.—At the final meeting of the Baltimore Section of the American Institute of Electrical Engineers on May 10 Mr. B. Dyer, of the National Carbon Company, presented a paper on "The Manufacture and Uses of Carbon Products." The paper was illustrated with lantern slides, and supplementing it was an exhibit of carbon in its various manufactured forms.

"Sun-Kissed" California Oranges Electrically Ripened.—The final ripening process in the preparation of California oranges for the market is the exposure of the fruit to steam vapor, which imparts the golden yellow color described on the labels by "sun-kissed" and other appetizing terms. In fact, however, electric heat is employed to a large extent in producing this steam vapor, electric immersion coils in open tanks of water in the ripening rooms producing the warm humidity required to give the final tint to the orange of commerce.

Electrolysis Agitation in Bradford.—The Commercial Natural Gas Company, of Bradford, Pa., is apprehensive that escaping electricity from railway return circuits has caused damage by electrolysis to the underground gas mains and water pipes of that city. Mr. Charles T. Sloane, Jr., of Buffalo, was recently retained as an expert to make tests on differences of potential on underground metallic structures. The city officials, representatives of the water department and of the gas company and of the Western New York & Pennsylvania Traction Company are interested in the investigation.

Excursion to McCall's Ferry, Pa.—The following organizations will participate in the excursion to McCall's Ferry, Pa., on May 21: The Baltimore Section of the American Institute of Electrical Engineers, the Engineers' Club of Baltimore, the Washington Section of the American Institute of Electrical Engineers and the Washington Society of Engineers. Through the courtesy of the officials of the Pennsylvania Power & Water Company a complete inspection will be made of the hydro-electric station of the company on the Susquehanna River, which transmits electrical energy at 70,000 volts to Baltimore.

St. Louis League of Electrical Interests.—Like the electric clubs in some other cities, the St. Louis League of Electrical Interests has decided to hold luncheon meetings weekly. The place of meeting is the private dining-room of the City Club on the top floor of the Board of Education Building, Ninth and Locust Streets. Here the members of the league will gather every Tuesday noon for luncheon, after which there will be a meeting, with a speaker, or some entertainment features. Mr. F. D. Beardslee is secretary of the club and Mr. Fred Johnson is chairman of the entertainment committee. The first of the weekly meetings was held on May 9.

Electricity for Harvard Class Day.—The traditional Japanese lantern, with its candle equipment, will be superseded this year at the Harvard class day exercises by electric incandescent lamps. The class day committee has decided to light the yard and delta around Memorial Hall with 4500 lamps, 3500 of which will be of the electric type, and a similar arrangement will be made in connection with the so-called senior spread. The change has been brought about as a result of the extinguishment of the picturesque but unreliable candle lanterns last year by a rainstorm which burst upon the ceremonies at their height. The lamps will be placed inside Japanese lanterns to preserve the artistic effect while securing rainproof operation. Energy will be supplied for this service by the Cambridge Electric Light Company.

Spring Meeting of A. S. M. E.—The local Pittsburgh committee of the American Society of Mechanical Engineers, of which Mr. E. M. Herr is chairman, has completed arrangements for the spring meeting to be held in the Hotel Schenley and the Carnegie Institute from May 30 to June 2. Trips will be made to the plants of the Universal Portland Cement Company, the Westinghouse factories, the works of the National Tube Company and of the Mesta Machine Company.

Sons of Jove at New Orleans.—A subscription dinner and entertainment was given by the Sons of Jove residing near New Orleans, La., in Noy's Restaurant at Spanish Fort, near the city, on May 6. Mr. H. F. Cameron is statesman for the order in Louisiana and Mr. Robley S. Stearnes presided as toastmaster at the dinner. The committee in charge of the affair comprised Messrs. W. E. Clement, contract agent for the New Orleans Railway & Light Company, chairman; M. S. Hart, J. W. A. Richardson and M. E. Hart.

Commonwealth Edison Branch of N. E. L. A.—At a meeting of the Commonwealth Edison branch of the National Electric Light Association in Chicago on May 2 Mr. E. F. Smith, chairman, announced that the membership of the branch has now reached 1020, an increase of 110 per cent since Nov. 1, 1910, when the present officers took charge. It was announced that the Commonwealth Edison Company has agreed to pay the expenses of six delegates from this branch to the New York convention of the N. E. L. A. An election to select these delegates is now proceeding. Mr. W. L. Abbott, chief operating engineer of the company, read an illustrated paper on "Maintenance of Service," giving some interesting facts about the operating branch of the business. There was a brief discussion in which Messrs. H. B. Gear, J. C. Manley and A. G. DeClercq took part.

The Edison Medal of the A. I. E. E.—The address on "Electricity in the Navy," to be made at the presentation of the A. I. E. E. Edison medal to Mr. Frank J. Sprague, noted in our issue for May 4, will be delivered by Commander S. S. Robison, of the Bureau of Steam Engineering, United States Navy. The award of this medal is made by a committee of the Institute consisting of twenty-four members, three of whom are appointed by the president each year to serve for a term of five years, three elected by and from the board of directors each year to serve for a term of two years, and the president, secretary and treasurer of the institute ex officio. The medal was designed by Mr. James Earle Frazer, and bears on its obverse a portrait of Mr. Thomas A. Edison and on its reverse an allegorical conception, "The Genius of Electricity Crowned by Fame." The first award was made, in 1909, to Prof. Elihu Thomson, and the second award, in 1910, to Mr. Sprague.

Cambridge Low-Pressure Turbine Plant.—The Cambridge (Mass.) Electric Light Company expects to place a low-pressure steam turbine equipment in operation within the next two weeks at its Western Avenue power plant, which is located in the southern part of the city on the north bank of the Charles River. The company is completing the installation of new equipment of a total value of nearly $135,000, including two low-pressure turbo-alternators of 500-kw and 1500-kw rating, switchboard relocation, conduit and cable extensions. Under the supervision of Prof. Ira N. Hollis, of Harvard University, consulting engineer for the company, an exhaustive investigation has been made of the possibilities of low-pressure turbine service, and, as stated by the company at a hearing last summer before the Massachusetts Gas & Electric Light Commission, the management expects to reduce the steam consumption from 22 lb. to a net of 15 lb. per kw-hour by the installation of this type of unit.

THE ELECTRICAL EQUIPMENT OF THE BOSTON & ALBANY'S EAST BOSTON DEEP-WATER TERMINAL.

Entire Service Supplied from Mains of Boston Edison Company.

THE operation of large tidewater terminals by electricity affords one of the most attractive fields for application of central-station power and lighting service that have lately been developed. The loading and unloading of vessels, the transfer of grain and other commodities between cars, elevators, ships and warehouses, the protection of merchandise in storage and transit from fire losses, and the heavy cost of delays at ports introduce problems of large engineering interest into the design of facilities for the safe and economical handling of products of the soil and factory. One of the most conspicuous examples of an electrified freight terminal is just at the point of completion on the waterfront property of the Boston & Albany Railroad at East Boston, Mass., where the railroad company has expended about $4,000,000 in the reconstruction and improvement of its grain elevators, piers, yard and warehouse facilities. The Cunard, Leyland and other transatlantic steamships dock at the piers of the railroad company at this point. Included in the improvement is a new fireproof grain elevator of 1,000,000 bu. capacity, costing approximately $1,000,000, and equipped with about fifty induction motors aggregating nearly 2200 hp. All the electricity used in the lighting and power service of the terminal is supplied by the Edison Electric Illuminating Company of Boston from its main generating plant at South Boston, on the opposite side of Boston Harbor.

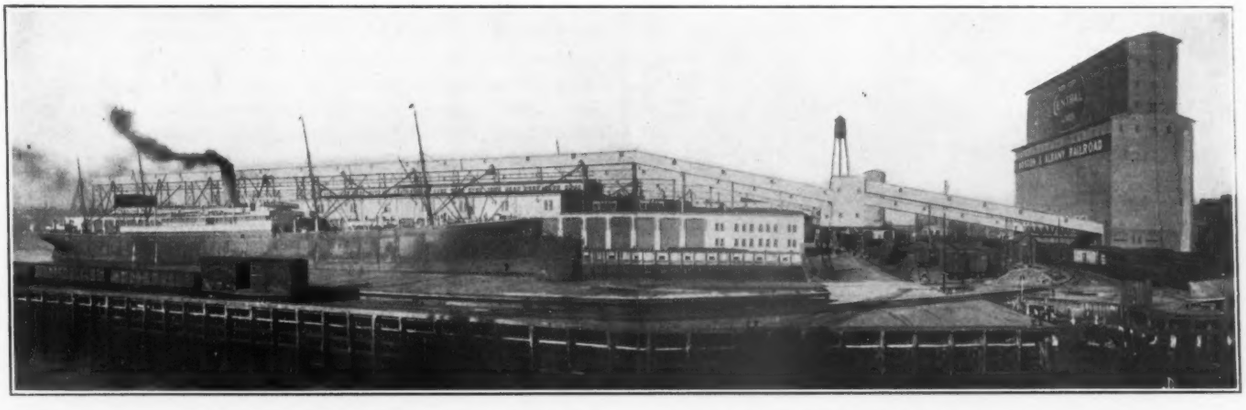


Fig. 1—General View of the Boston & Albany Railroad Piers, Warehouses and Elevators.

Electric power is used on the terminal property mainly for the operation of the car-pulling, hoisting, cleaning, dust-gathering, shoveling, conveyor and shipping equipment of the grain elevator; for the driving of conveyors running through elevated galleries and serving the various steamship piers for delivery to the holds of vessels; in the operation of high-powered centrifugal fire pumps, and the minor auxiliary applications. The buildings on the property are all lighted by electricity; the yard is illuminated by flaming arc lamps placed at advantageous points, and several important systems of signaling and communication by telephone and otherwise are in service in connection with the routine operation of the terminal and its protection against fire. Although the demand for energy is somewhat intermittent on account of the variations in the arrival of vessels and cars, it is often maintained in considerable volume for many hours of the day and night, and the possibilities of the equipment provide for the needs of the port for many years, with special reference to the deepening of Boston Harbor by the United States government. The present installation of grain-handling equipment accommodates five ships of the largest size and tonnage, which can be loaded simultaneously with grain and other commodities, and the conveyor-belt system provides for the delivery of 40,000 bushels per hour. The piers at which the Cunard and Leyland Line ships dock are among the largest on the Atlantic seaboard, each being 780 ft. long and 240 ft. wide.

From the electrical point of view, the most interesting feature of the terminal is the use of electric power in the grain elevator, where the labor requirements have been cut to the minimum. A striking feature of the motor service is the installation of a system of control centralized in a switchboard room on the ground floor of the elevator, and including in its equipment all the starting and motor-controlling devices necessary for regular operation, only emergency stopping buttons being provided at the motors themselves. With the exception of a motor which operates a passenger elevator, all the motors are started from the switchboard room upon receipt of an annunciator signal from the operator at the particular machine which is to be operated. A separate circuit is run in iron conduit to each motor, and the control is effected by the use of a double set of busbars with compensator connections, by which subnormal voltage is applied to the individual motor in starting, without the installation of any starting coils or transformer connections outside the switchboard room.

The railroad company investigated the desirability of constructing a central-power plant on the property for the electrical service, but on account of an equitable arrangement made with the Boston Edison company this plan was abandoned. A steam-heating and pumping plant has been built on the terminal property, and in one section of this building the Edison service is brought in by underground cables carrying three-phase current at 13,200 volts and 60 cycles. The pumping station is a brick and steel structure with concrete foundations, and a section about 25 ft. long by 21½ ft. wide has been set apart for the switching apparatus required by the incoming electrical feeders. Five panels for 6600-volt present and 15,000-volt ultimate service are installed. The cables are brought through potheads into concrete switch cells, and oil switches are provided in each of the three incoming lines which serve the terminal. The connections provide for duplicate feeder lines from the Edison plant in South Boston, with an emergency line connected with their East Boston substation. Two 300-kw step-down transformers, reducing the voltage to 440 three-phase, for the operation of fire-pump motors, are installed in the switch room of the pumping station and connected with the busbars through oil switches by underground cables carried beneath the floor. From the entrance of the Edison service two No. 0000 three-conductor, lead-covered cables installed in underground conduit are run to a special transformer station located near the grain elevator, and from this building practically all the electrical distribution of the terminal is controlled and measured.

The transformer station is a brick and steel structure 50 ft.

long by 22 ft. wide, one story in height, located about 200 ft. north of the grain elevator. The Edison high-tension service is brought into the building by pothead cable connections and passed through automatic oil switches to a set of three-phase horizontal busbars located inside concrete cells in one corner

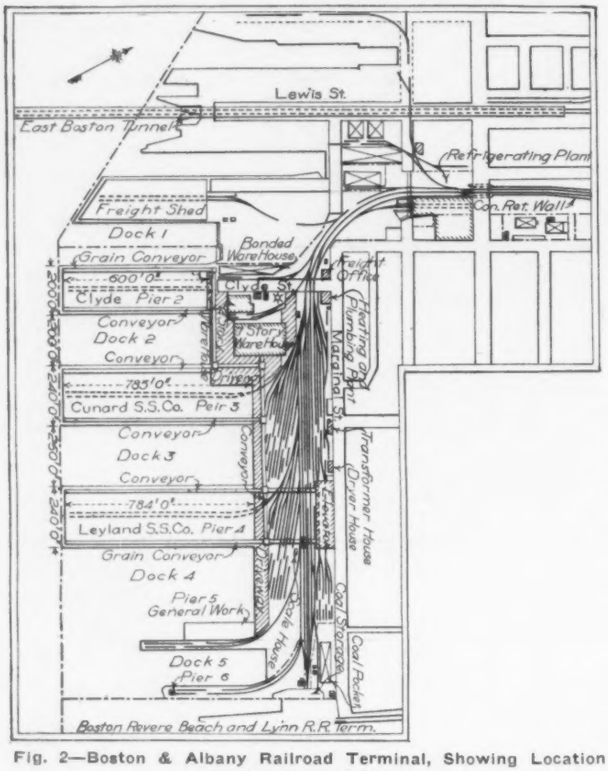


Fig. 2—Boston & Albany Railroad Terminal, Showing Location of Elevator and Piers.

of the building. The switchboard in the transformer house contains six power panels and seven lighting panels. Four of the power panels are used in the main control of the grain elevator, piers 3 and 4 (leased by the Cunard and Leyland companies) and the seven-story warehouse. Two spare power panels are provided for future service. The lighting panels include the main control switching equipment for the illumination of the entire terminal, including the grain elevator, seven-story warehouse, piers 3 and 4, freight offices and yard. Two spare lighting panels are provided.

Each power circuit is equipped with an indicating wattmeter, a recording wattmeter and an oil switch with automatic trip, operated on overload. Similar equipment is installed on the lighting panels, and the switchboard is further provided with special current and potential terminals so that tests of the accuracy of switchboard instruments can be made from the front of the panels without the necessity of temporary wiring at the rear of the board. All the current used in lighting service is metered by the Edison company before it leaves the transformer-house switchboard, and the power consumption is also metered in the same building. A demand meter is installed on the board near the last power-control panel. In general, the terminal lighting and pier motor service is supplied by underground cables running from the transformer station to the south side of the yard tracks, where a riser terminating in a pothead connects with overhead feeders running to distribution centers in the various piers and warehouse buildings. The aerial feeders are run on insulators attached to the steel structure of the grain-conveyor galleries, and are anchored at towers of the latter with eye-bolts, turnbuckles, strain insulators and cable clamps. Between these points, where the feeders cross the steel braces of the galleries, they are supported on glass cable insulators carried on locust pins set in 4-in. x 5-in. cross-arms attached to the structure.

The electrical supply for the grain elevator is derived from the transformer plant by nine 1,500,000-circ. mil cables carried in underground conduit from the power panels to the switchboard-room of the elevator. Two No. 0 three-conductor cables are also installed in the underground service to the elevator for lighting purposes. The switchboard equipment of the operating room of the elevator consists of fifteen panels, with switches and other apparatus for power service and a two-panel board for lighting. All motors operating the conveyor belts in the conveyor galleries are controlled from the switchboard-room in the same manner as the motors in the elevator proper.

The elevator is 269 ft. long x 73 ft. wide, and has a total height of 185 ft. 8 in. from the base of the track rail in the yard to the ridge of the cupola roof. The building contains 192 steel storage bins, 72 ft. deep; nineteen elevators or grain "legs," scrubbers and cleaners, belt conveyors, a dust-collecting system, car-puller equipment and scales. A Hess grain-drier equipment is installed in a separate building just outside the elevator proper. All the motors are of the General Electric Company's induction type, and all except that on the passenger elevator in the elevator are equipped with rotors of the squirrel-cage type. The motors in general are free from load at starting, and are brought up to full speed by the switchboard operator before the load is applied. The motor starting is accomplished by hand operation of the switches. The signal system consists of a push button, annunciator and electric bell service between the switchboard-room and each motor-driven machine, the circuits being operated at 75 volts. An ammeter is installed in each motor circuit at the switchboard to indicate when the motor has attained full speed, and when this occurs the operator signals the machine attendant, who applies the load. In regular operation a machine attendant who desires to start a conveyor, leg or other apparatus presses a button, which rings a bell and throws a drop in the switchboard-room annunciator. The switchboard operator closes the motor switch, throwing the unloaded motor upon a special set of auxiliary busbars carrying either 40 per cent or 58 per cent of the normal voltage, and the motor immediately accelerates to full speed, the normal voltage being applied at the proper time by the switchboard attendant, who throws the motor circuit upon the normal or 440-volt bus. When the ammeter indicates that the motor has reached its full speed the switchboard attendant pushes a button that rings a bell at the machine, indicating that the load may be applied. The operation takes but a few seconds, and all complications of special starting and stopping

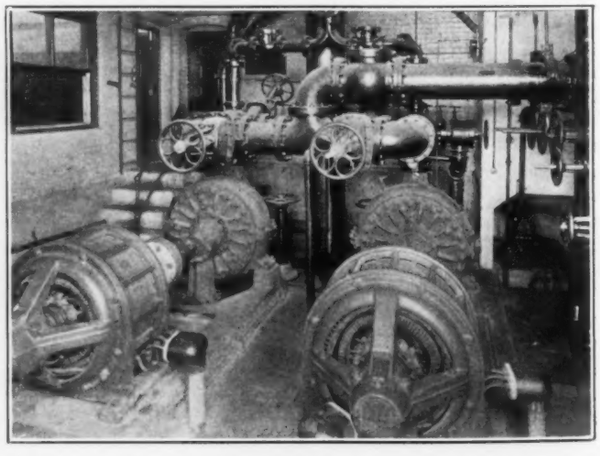


Fig. 3—Induction Motors Driving Two-Stage Centrifugal Pumps.

equipment are eliminated at the machine itself. The subnormal voltage on the auxiliary busbars is obtained by connections with one of two compensator coil installations, and the operator selects either 40 per cent or 58 per cent of normal voltage, depending upon the distance of the motor from the switchboard-

room and its size and general operating characteristics. Any motor can be stopped by the pressing of a button placed immediately by the machine, so that emergencies can be taken care of without loss of time, and in connection with the belt conveyors the wiring has been arranged to provide for the

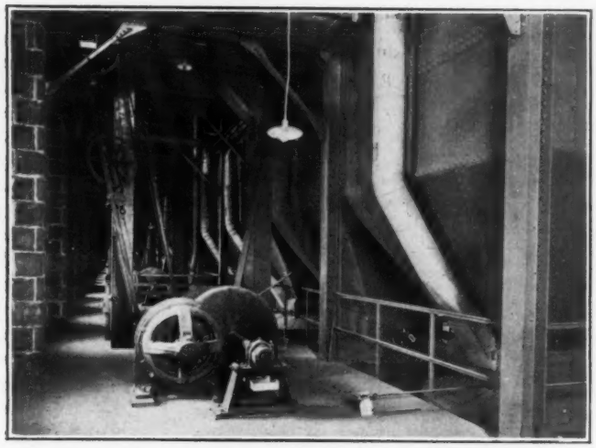


Fig. 4—50-hp Motor Driving Elevator Leg.

successive stopping of all motors involved in a sequence, proceeding from the grain elevator outward toward the piers through the galleries containing the distributing belt conveyors. In case an attendant in a gallery notes that something is wrong he presses the emergency motor stop button located near the ordinary signaling button, and this operation immediately sets in motion an emergency stopping-switch mechanism in the switchboard-room, which passes a contact arm over a group of relay circuit-closing points connected with the tripping coils of all oil switches controlling the motors driving the grain-conveying apparatus. The motors nearer the elevator on the shipping system are stopped first in order to avoid serious trouble through the piling up of the grain at any point in the delivery and distribution system, and the process of stopping proceeds seriatim down through the galleries until the last motor on the shipping system is reached. This may or may not be the motor at which the attendant operated the emergency button, but in any case the system as a whole is stopped from the proper end and the grain conveyors left in condition to start again as soon as the particular local difficulty which occasioned the shut-down is remedied. The galleries and elevator are provided with an intercommunicating telephone system, so that little time is ordinarily lost in locating and attending to troubles that develop in any locality.

In the elevator the equipment is installed so as to take the utmost advantage of the action of gravity. Grain delivered from the cars is passed by motor-driven shovels into screened bins, from which it is hoisted to the garner floor near the top of the elevator monitor. It is dropped by gravity through the scale floor to the distributing section, where an ingenious system of radial steel spouts feeds it to the numerous bins beneath. The larger hoppers of the scale system hold 96,000 lb. of grain each. The distributing floor below the scale floor is equipped with a 36-in. 4-ply reversible belt conveyor running its entire length and provided with a reversible tripper and two movable loaders. In the shipping section of the elevator are three belt conveyors feeding the outgoing conveyor system leading to the towers and galleries of the terminal yard. In general the distributing belts are 36 in. wide each and run at a speed of about 1200 ft. per minute. The conveyors running above the piers are installed 66 ft. above the floor of the wharf and discharge into the steamship holds through spouts of telescopic design equipped with 30-ft. steel booms controlled by hand-winches. The entire elevator is designed to facilitate the rapid transfer of grain from any bin to any other, and by the use of the appropriate system of spouts, legs and conveyor belts the grain can be passed through cleaning, weighing, storage or drying processes with the minimum loss of time. The elevator is equipped with a dust-collecting system connected with about sixty sweeps installed on the different floor levels, and the dust gathered is forced by motor-driven fans through a pipe system to a dust house, where it is packed in bags by special machinery and sold for mixed feedstuffs.

The principal motors required for the elevator service are given in the following tabulation:

Number.	Horse-power Rating.	Speed R.P.M.	Service.
1	100	720	Drives 80-in. dust-collector fan on first floor.
1	75	720	Drives 70-in. dust-collector fan on top floor.
1	75	720	Drives drier-plant machinery and belt conveyor.
1	75	720	Drives short shipping belt and belts in gallery.
1	75	720	Drives short shipping belt and belts in gallery.
1	75	720	Drives belt conveyors between certain towers.
6	55	514	Drive six receiving elevator legs.
6	55	514	Drive six shipping elevator legs.
5	55	514	Drive five cleaner legs.
1	35	600	Drives two elevator legs for drier plant.
1	35	600	Drives car puller machinery on first floor.
1	35	900	Drives shovel line shaft.
1	20	1200	Drives reversible belt in cupola (distributing floor).
5	20	1200	Drive Eureka double cleaning machines first floor.
1	15	1200	Drives reversible shipping belt conveyor.
5	15	1200	Drive five single Eureka cleaning machines on first floor.
1	10	....	Drives passenger elevator in elevator building
1	5	1200	Drives dust-packing machinery in dust house.
3	100	720	Driving belt-conveyor system (temporary connection).
1	75	720	Driving belt-conveyor system (temporary connection).

The passenger elevator has a capacity of 2000 lb. at a speed of 75 ft. per minute and is equipped with electromagnetic push-button control at each floor, with safety circuit-closing device on all gates. The interior of the car is also provided with push-button control for each floor, the buttons being

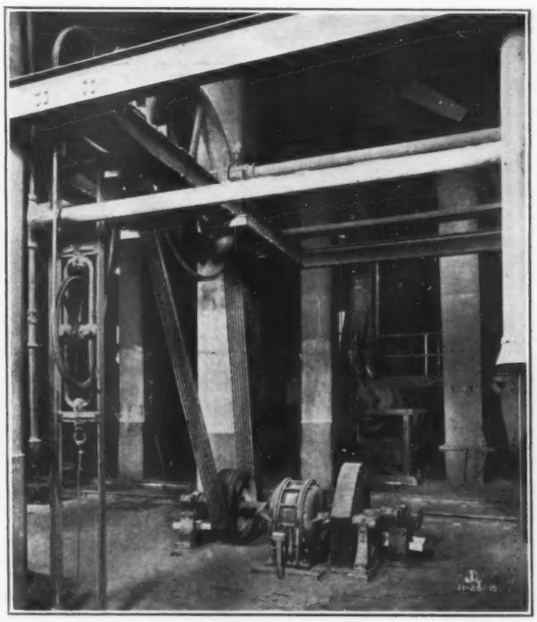


Fig. 5—35-hp Motor Driving Automatic Shovel Equipment.

fitted with platinum contacts. Each of the single and double receiving separators in the grain-cleaning machines has a capacity of 5500 bu. per hour. There are twelve shovel machines for emptying cars, there being two in connection with each receiving elevator, arranged to unload cars on either of

two receiving tracks which enter the building. The car-puller is of the heavy geared type, located in the basement of the elevator, and it is equipped with four drums carrying ⅝-in. steel cable, installed to pull cars in and out of the house on either track. This electric hauling device obviates the necessity for the entrance of a steam locomotive into the elevator under any normal conditions of operation. In addition to twenty-four steel distributing spouts serving the steel grain bins, one loading spout is provided at the front of the first receiving elevator to enable cars to be loaded when necessary, although this work is rarely within the province of the elevator. Bagging spouts are also provided on the north side of the elevator for the benefit of the local trade. Mechanical trippers are installed on the belts to facilitate the discharge of grain at points where it is necessary to change its direction of flow. These trippers can be set to discharge at various points, and are arranged to be propelled by the driving power of the belt along the gallery, as desired. Concentrator rollers are provided in the belt installations at the loading points of shipping conveyors, to prevent the grain from spilling off the sides of the belts. The elevator buckets for the receiving, shipping, cleaning and transfer legs are each 7 in. x 7 in. x 20 in. in dimensions. The elevator boots are of cast iron, and a flexible system of slack adjustment by idlers and pulley movement is in service. The grain drier has a capacity to dry and cool 15,000 bu. of damp grain with 7½ per cent moisture by weight in twenty-four hours. A ball-bearing safety device is installed at the driving pulley end of the legs to prevent its slipping backward in case of an interruption in the power supply.

The switchboard in the elevator-operating room is built of white Italian marble panels, there being thirteen panels for motor controls, three for compensator controls and two for lighting control service, with a single panel for incoming main service. On account of the shape of the room, the board is installed in three sections, the total length of the sections aggregating about 51 ft. Ammeters and voltmeters are used on the board and, as stated, each motor circuit is provided with an ammeter, with a bypass connection which enables the operator to read with fair accuracy the relation between the current and the motor speed when handling the motor-starting system. In general, the motor-feeder panels are provided with an ammeter and a double-pole oil switch installation in two sets of switches, one of which connects the motor to one set of busbars and the other to the auxiliary busbars. The switches controlling the motors driving the belts in the towers, drier house and dust-collector fan equipment, shipping and receiving elevators, car-pulling machinery, shovels and dust-packing machinery are oil switches of special automatic type, provided with two overload series trip coils and an auxiliary trip coil for opening the switch. The auxiliary trip coils are connected with the circuits of the system for the automatic control of the motor switches by push buttons, the auxiliary trip coils operating at 75 volts, as above mentioned. About eighty-one push buttons are in service on emergency motor trips. Selector switches are installed on the compensator panels, by which either 40 per cent or 58 per cent of normal voltage can be thrown upon the auxiliary busbars, these switches being interlocked so that the two voltages cannot be applied to the buses at the same time. The lighting circuits are controlled through knife switches and the panels are equipped with inclosed fuses in each branch and ammeters and a test voltmeter. The board as a whole is equipped with two 4-point plugs and two 2-point plugs and thirty receptacles for testing voltage and grounds. The incoming mains are connected to busbars on the incoming-mains control panel, and a current transformer for a totalizing ammeter is included in the circuit before other connections are made. Cross-connecting cables running beneath the floor are provided to the second section of the power board, all lugs being large enough to receive a 500,000-circ. mil cable.

The motor-starting compensators are of the inclosed type, each consisting of three coils connected in star, without switches or other operating mechanism. The coils are of the floor type and are immersed in oil. The taps are taken at points giving the fractional voltages above mentioned, and the compensators may be used in multiple on either of the voltages if desired. A lamp signal system, with red and blue indications, is installed in connection with the work of the weigher and the elevator attendants, the code applying mainly to the operation of mechanical valves on the elevator bins and spouts.

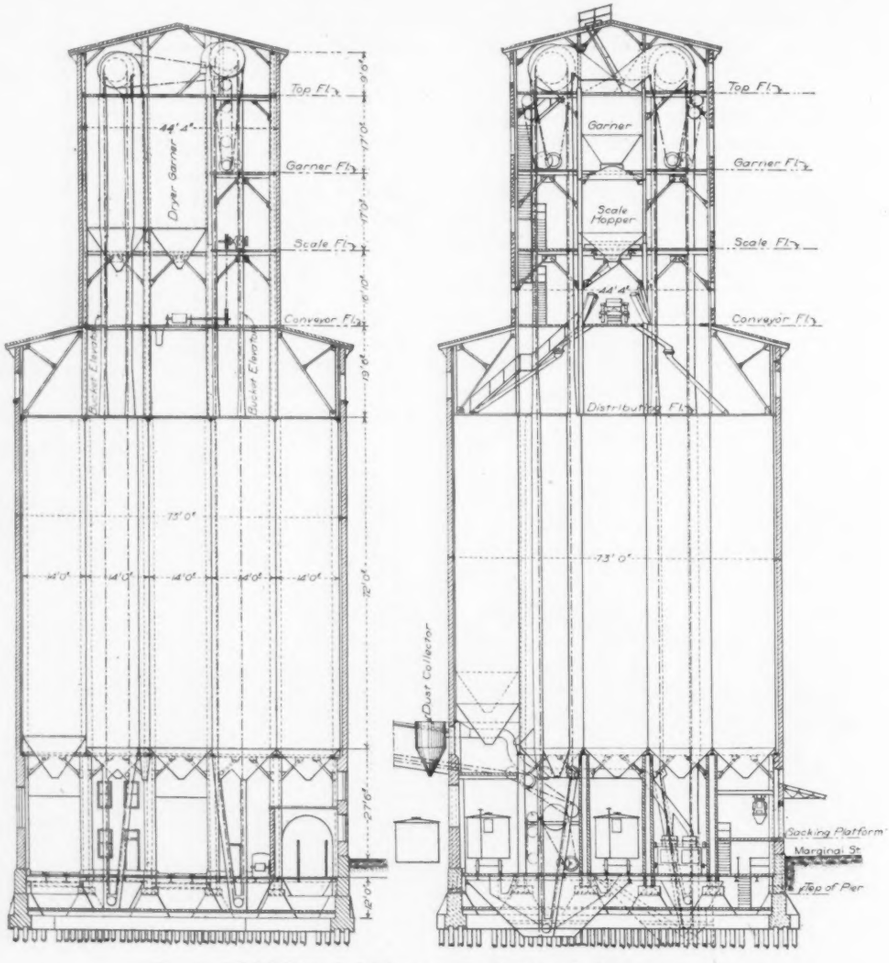


Fig. 6—1,000,000-Bushel Elevator for Boston & Albany Railroad.

All wiring for the power and lighting service in the elevator is carried in iron conduit, except where pendent connections are provided to incandescent lamps. A separate conduit, with all conductors in each circuit in one pipe, is run from the switchboard to each motor. The lighting circuits are run as feeders to distribution panel boxes in the usual manner, with subdivisions in the various departments controlled from local

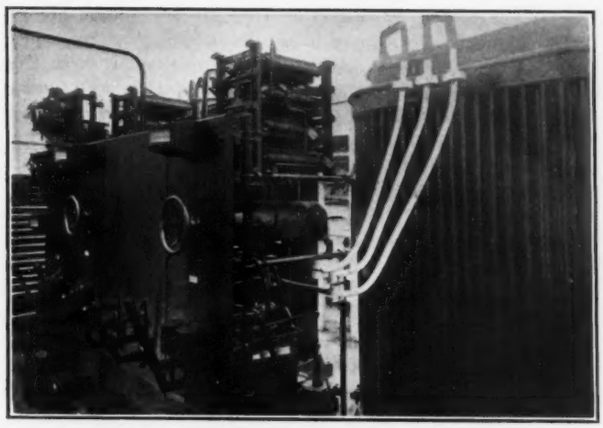


Fig. 7—Panels Controlling Induction Motors in Pump Station.

box fuses and switches. The feeder circuits to the different motors in the elevator and galleries are as follows:

Horse-power of Motors.	Size B. & S.	Diameter of Conduit in Inches.	Motor Service.
100	00	2	Dust-collector 80-in. fan.
75	0	2	Fan, drier equipment, belts, conveyors.
55	1	2	Receiving and shipping legs, cleaner legs.
35	4	1½	Elevator legs, car puller.
20	6	1¼	Belt, cupola, also double cleaning equipment.
15	8	1	Single cleaning machines.
10	10	1	Passenger elevator.
5	10	1	Dust-packing machinery.

In general, the motors are located either on the floors of the elevator adjacent to the apparatus driven, on special sub-bases designed for direct-connected service, or on platforms separated from the machinery, both belt and rope driving being in service. The driving of the elevator legs is effected by twelve ropes, 1 in. in diameter, each connecting the motor pulley with the head pulley of the leg mechanism. The separation of the motors from the complex mechanism which they drive enables electrical matters to be handled with the utmost ease, keeps the wiring away from moving belts and other parts, provides for easy inspection and enables the mechanical connections of the motors to be made thoroughly efficient. The elevator is lighted in the main by 16-cp lamps, placed where they will give effective illumination, notably in the vicinity of machinery, scale beams, deck spouts, passage-ways and stairs. The distribution circuits are all controlled in the panel boxes above mentioned, with the exception of those in the stair tower of the elevator, which are wired for cutting on or off from each end of the tower. The distribution circuits for lighting are so wired that the difference of potential between any lamp and the busbars in the panel box from which the lamp is controlled will not exceed 1.5 volts. A maximum of twelve lamps is connected to any single lighting distribution circuit and the circuits are arranged so far as practicable to divide the load evenly between the two sides of the three-wire system. The lighting distribution circuits are of the two-wire type. About 400 lamps are in use in the elevator and 120 lamps in the towers and galleries. The office of the superintendent of the elevator, that of the weigher, and the switchboard-room are heated by five electric radiators, one of 4000 watts rating being in the superintendent's quarters and two of 4000 watts rating being in the switchboard-room. The

Fig. 9—Switchboard Room.

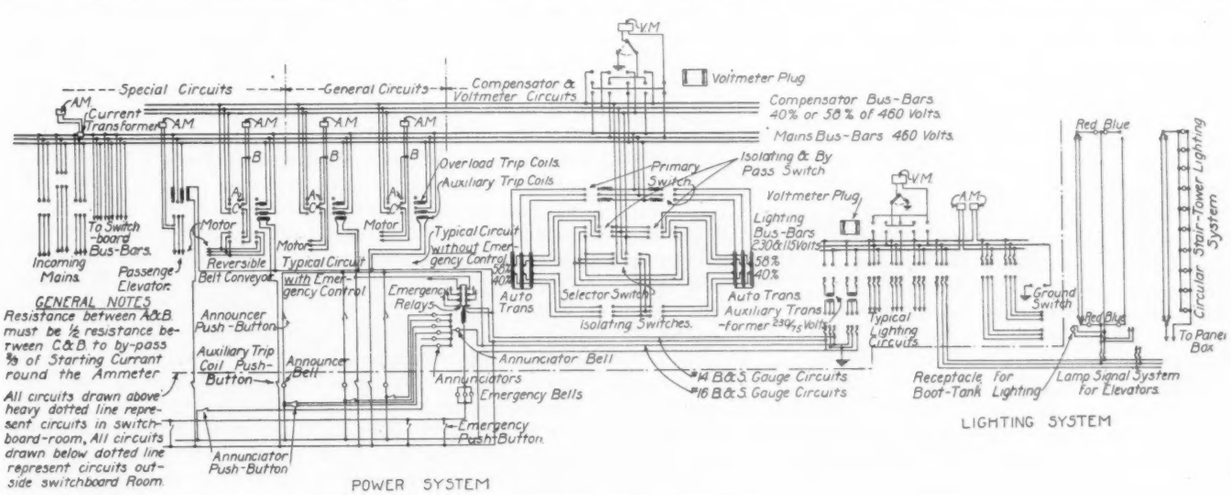


Fig. 8—General Wiring Diagram.

heaters in the weigher's office are installed in two 2000-watt units. No steam distribution is installed in the grain elevator, there being no occasion to heat the bins, garner, scale distributing and gallery sections.

The conduits for the general motor and lighting service are carried from the switchboard-room to the stair tower at the northwest of the elevator and thence proceed in the form of risers to the top, garner, scale, belt conveyor and distributing floors of the elevator. For the panel boxes on the first floor of the elevator the conduits cross the switchboard-room below the floor and run directly to the panel boxes on the west wall, rising through the floor to make the connections. For all motors on the first story and the first story platforms of the elevator, and for all motors and panel boxes in the belt-conveyor system, the conduits are run to the east end of the superintendent's office below the floor. The first floor conduits continue on this level; the first story platform conduits rise, for motors on the sacking platform, to the under side of this platform and, for motors on north and south motor platforms, to the under side of the bins. The conduits for the gallery under the shipping platforms take the same general course as the conduits for motors on the motor platforms. All conduits for the belt-conveyor system are run to a central distributing tower and thence branch to the various points of consumption. All conduits are carried to the extreme point where the conductors, and not the conduits, make connections. All lamps in the belt-conveyor system are suspended direct from the conduit, pendent lamps being used only in the elevator building, drier plant and other places where it is not feasible to carry conduits to the lamps. Provision is made for attaching portable lamps to the elevator-boot tanks, for temporary inspection or repairs.

The contact-making device which stops the motors in case an emergency button is pushed is designed to allow an interval of 30 seconds to elapse between the opening of the first switch and the last, and also is arranged to open the common main for all the cricuits after all the trip coils on the motor oil switches have been actuated, so that the system will return to its starting point electrically. The main wiring for auxiliary systems takes the same general course followed by the power and lighting feeders. The neutral of the three-wire lighting system is grounded, and the lead covering of all cables is grounded. The telephone system of the elevator and galleries is of the intercommunicating type, with thirty-two stations. Ringing current is supplied by the 60-cycle, 75-volt service, and the talking current is obtained from dry batteries having a normal potential of 24 volts between outer terminals. Telephone extension bells are installed in the galleries away from the instruments, as well as at the sites of the latter.

The lighting of the piers is accomplished mainly by incandescent lamps, 40-watt tungstens being used in the offices, immigration rooms, etc., and 60-watt lamps hung about 20 ft. from the floor in the sheds of the first story. About 1000 lamps are in use in the two piers at which the Cunard and Leyland line ships dock and these are supplied by feeder circuits running from the transformer station near the elevator to distributing switchboards and branching circuits running from the latter near the entrances to various centers of local distribution in the buildings. The three-wire system is used as in the grain elevator. Each pier is provided with a power and lighting panel containing triple-pole knife switches and fuses for lighting and power service, and a recording wattmeter is used on both piers in the lighting leads. Feeders are carried at least 30 ft. above the rails wherever they cross the yard tracks. A No. 0000 electric elevator service cable is run from the service panels in the piers to a dock elevator installation used in passenger service on Pier No. 3. Provision has been made of separate switches whereby the night watchman on the pier can always keep a 60-watt tungsten lamp in service ahead of him in making rounds so that it is unnecessary to carry a lantern on the piers.

The pumping plant and distribution service for fire protection are unusually complete. The pumps are drivin by induction motors and a contactor switching installation is provided in the pumping station whereby an auxiliary pump motor is arranged for automatic starting and stopping in connection with the height of a float in a 100,000-gal. elevated tank that furnishes the initial pressure and protection in connection with the sprinkler system on the piers. The main fire pumps are of the Platt Iron Works manufacture, of the centrifugal type, and each is capable of delivering 1500 gal. per minute against a head of 125 lb. per square inch. The auxiliary pump, which automatically supplies the elevated tank with water, is capable of delivering 150 gal. per minute against the foregoing pressure. A complete watchman's clock system is in service, and the railroad company is experimenting with an electric push button installation at monitor nozzles and hose valves so that when a fire occurs, by pressing the button, a solenoid equipment at the main water valves will be operated and water turned immediately into the dry pipe systems. An annunciator system will also be installed in connection with an elaborate sprinkler system which is now in service. There are also A. D. T. connections planned for the system.

The principal electrical contractors on the terminal work are as follows: Grain elevator and electrical installation complete, with all mechanical features of the former, Witherspoon-Englar Company, Chicago, and motors, General Electric Company, Schenectady, N. Y. The improvements at East Boston were begun mainly as a result of a disastrous fire which occurred about two and one-half years ago. All of the improvements have been carried out under the direction of the engineering department of the Boston & Albany Railroad.

ELECTRICALLY DRIVEN TURBINE SINKING PUMPS FOR MINES.

By E. W. Jansen.

THE application of electricity in mines is far more advanced abroad than in the United States. Especially in Germany electricity is extensively employed for winding engines, rock drills, pumps, fans and other motors and for lighting. Among these applications one of the most interesting is undoubtedly the electrically driven turbine sinking pump for draining the bottom of a pit while sinking new shafts, and the object of this article is to give a description of the electrical equipment of such pumps without going deeply into their construction or mechanical details.

The electrically driven pump offers great advantages over its steam competitor. It does away with the usual serious hindrance to workmen on account of escaping steam and of increased temperature in the shaft. As the fresh steam has to be led in from the surface the condensation in the pipe line is considerable even with lagging. Due to the latter, the weight of the line is far in excess of the electric cable. Another important point to be considered in the design of sinking pumps is the amount of space they require with reference to the cross-section of the shaft. In this respect the electric outfit is decidedly superior. Still another disadvantage of the steam-driven equipment is caused by its swaying in the shaft, due to the reciprocating motion. Besides overcoming a number of the disadvantages of the steam-driven pump, the electrically driven turbine pump has a much higher efficiency.

In a few instances electrically driven pumping outfits of the reciprocating type are found. These have the disadvantages of swaying and are larger and heavier than the turbine outfits. Another method used abroad for draining the pit while sinking new shafts is the water-lifting device built on the Tomson principle, or so-called bailing process. This necessitates the installation of a large, heavy winding engine with drum and a battery of boilers, which in most cases is of far larger size than needed for the raising of ore after the shaft is in operation. The cost of operation is two to one as compared to the electrically driven

turbine pump. This result was actually ascertained by comparing two installations working under similar conditions in the potash mining district in Germany.

The motor driving the pump is mounted directly over the latter with a heavy casting between them, to which both are bolted, and the two are joined to each other by a flexible leather band coupling. As shown in Fig. 1, the whole pumping outfit, consisting of motor, pump, delivery and suction pipe with sieve, and certain control apparatus, is mounted in an iron frame. From the pump the water is pressed through two pipes which run along the iron frame to the upper platform, where they join by means of a siamese connection. In this section is a check valve and directly above it a regulating gate valve.

Two stages or platforms are provided with connecting ladder for the attendant. The frame containing the apparatus is suspended in the shaft by a steel rope from the surface and lowered from time to time by means of a winch as the depth of the shaft progresses. During the sinking of the shaft the equipment has to be raised frequently while the pit is being blasted to prevent flying missiles from striking the machinery.

The end of the steel rope is fastened to a beam or other support on the level of the winch and passes under a pulley mounted in the framework of the pump. This winch raises and lowers the pump at the rate of from 3.5 ft. to 7 ft. per minute, corresponding to a speed of from 7 ft. to 14 ft. per minute of rope being wound on the winch drum. A corrugated-iron roof over the framework protects the attendant against injury from falling missiles and water.

The steel ropes are also employed to steady the pipe line by means of iron bands at intervals of approximately 8 ft. to 10 ft., as shown in Fig. 2. The electric cable is clamped to the same iron bands, also shown in Fig. 2. In order to avoid friction and a possible clamping of the steel ropes passing through the eyes at both ends of the iron bands these are lined with bronze.

As the depth of the shaft increases new sections of pipe are added at the top, while the cable is lengthened by unreeling it from a drum specially constructed for this purpose. The pipe sections are from 8 ft. to 10 ft. in length.

In very deep shafts the winch and drum are placed in a pumping-room excavated in the side of the shaft about 600 ft. beneath the surface and the water delivered from the sinking pump is carried to a reservoir or basin in this cavity, from which it is pumped to the surface by means of a stationary centrifugal, a turbine-pumping set, or a belted duplex pump.

In some installations the depth of the shaft is not so great, but the quantity and quality of water is such that it has to be pumped to the surface in several stages. In the installation at pit V of the Consolidated Alkaliwerke Westeregln, a potash mine in the vicinity of Magdeburg, Germany, the first stationary pumping set is placed 285 m (935 ft.) beneath the surface. The shaft is now being deepened and upon reaching a depth of 428 m (1480 ft.) another stationary pump will be installed. Upon completion of the shaft the third one will be erected at the lowest level at a depth of 544 m (1780 ft.). In this instance a special cavity was excavated just above the first stationary pumping set for the winch and drum.

The suction pipe projecting from under the frame has at its lower end a specially constructed coarse sieve to prevent small stones and other solid matter from being drawn into the pump. The length of the pipe varies according to conditions, but is found in lengths up to 25 ft.

The length of the delivery line sections and suction pipe limits the depth which may be drained without stopping the motor. The size and construction of the centrifugal or turbine pump depends on the conditions for which it is designed—that is, the greatest delivery head. The parts subjected to wear and tear, particularly the impellers and diffusion vanes, are made of hard bronze, the actual composition of which depends on the amount of salt in solution and percentage of foreign matter in the water. At the beginning of sinking a shaft the delivery head is much smaller than the normal head for which the pump is constructed, and as the sinking progresses the head increases. These varying conditions may be met by temporarily reducing the number of stages by removing runners and substituting blanks.

The motor used for these turbine-sinking pumps is an inclosed, vertical-shaft alternating-current motor with a special water-cooled frame or casing. Due to the difficult conditions under which it has to operate, the three-phase induction motor with squirrel-cage rotor is preferable. This type has been found most reliable as it possesses the simplest construction and needs the least repair. It has been found that direct-current motors are not suitable as the frame must be constructed to have the collector and brushes easily accessible, and

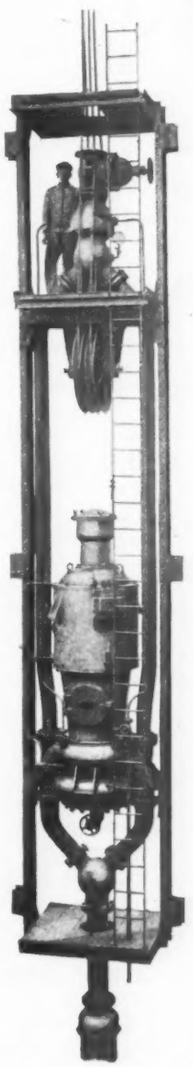


Fig. 1—Pump and Motor Mounted in Iron Frame.

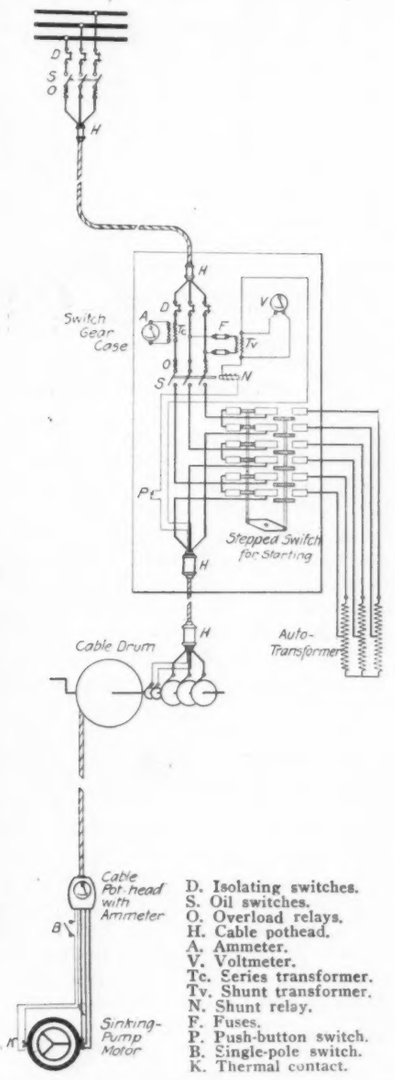


Fig. 2—Diagram Showing Electric Wiring.

experience has shown that they cannot operate successfully in the damp conditions for any length of time. The motor used is of the fully inclosed type with upper bearing of the thrust and lower of the collar type, both equipped with oil-lubricated ball bearings. The frame is constructed with a water jacketing so divided that the cooling water touches all parts. For this jacketing water is taken from the lowest stage of the pump, a reducing valve being inserted to reduce the pressure. A water purifier with fine sieve is built in the pipe leading to the motor to prevent clogging of the jacketing through impurities. In cases where the pit water possesses chemicals in solution or is exceedingly muddy and warm special cooling water is led in from the top. This was the case in the Alkaliwerke Westeregln installation mentioned previously. With large-size, high-speed

motors special water-cooling coils are built into the oil reservoirs for the bearings. The same water for cooling the motor is used for the turbine pump, which is also jacketed. A fan is constructed on the rotor of the motor to circulate the inclosed air, bringing it in contact with the water-cooled sides of the

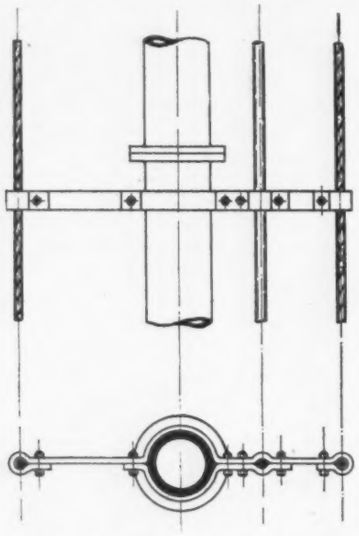


Fig. 3—Details of Pipe-Line Cable and Steel Ropes.

frame. The casing also possesses valves for cleaning the jacketing and letting the water run off when out of use.

With the turbine pumps there is always the possibility of their sticking and becoming clogged, and of foreign matter being caught and carried along with one of the impellers, thereby greatly overloading the motor. To prevent the motor from becoming unduly warm a thermal contact or fuse is built into the side of the motor, which is connected to the release of the main switch. With overheating of the motor this contact fuses, actuates the no-voltage release and throws off the motor. As a precaution against moisture the windings of the motor have a special damp-proof insulation.

The normal rating of these motors is from 50 hp to 225 hp, corresponding to a delivery of from 1 cu. m to 3 cu. m per minute (13,200 gal. to 792,000 gal. per hour), and the normal synchronous speed may be taken at 1500 r.p.m. The average height for the pressure head may be taken as 200 m (756 ft.). The weight is approximately 25 per cent greater than open-type motors with horizontal shafts for the same output and speed. Motors with outputs as high as 500 hp have been built.

The equipments shown in Figs. 1, 4 and 5 were built by the Siemens-Schuckert Werke. The turbine pumps were delivered by Gebrüder Sulzer, of Winterstur, Germany. The one shown in Fig. 1 was constructed for the Société des Mines de Jarny, at Jarny, France. It delivers 5 cu. m per minute (66,000 gal. per hour) against a head of 225 m. (738 ft.). The motor has an output of 400 hp at 2000 volts, 50 cycles.

The equipment illustrated in Fig. 4 was built for the Aachener Hüttenverein at Rote Erde, near Aachen, Germany. The pump is able to deliver 4 cu. m per minute (52,800 gal. per hour) with a head of 75 m (246 ft.), running at a speed of 1460 r.p.m. (1500 r.p.m. synchronous speed on a 50-cycle circuit). The motor is constructed for 100 hp at 325 volts.

Illustration No. 4 shows an outfit delivered to the Dutch State Limberg Mines for Pit Wilhelmina at Heerlan, Holland. The pump has an output of 1 cu. m per minute (13,200 gal. per hour) with a delivery head of 235 m (771 ft.) at 1450 r.p.m. The motor is constructed for 90 hp at 500 volts.

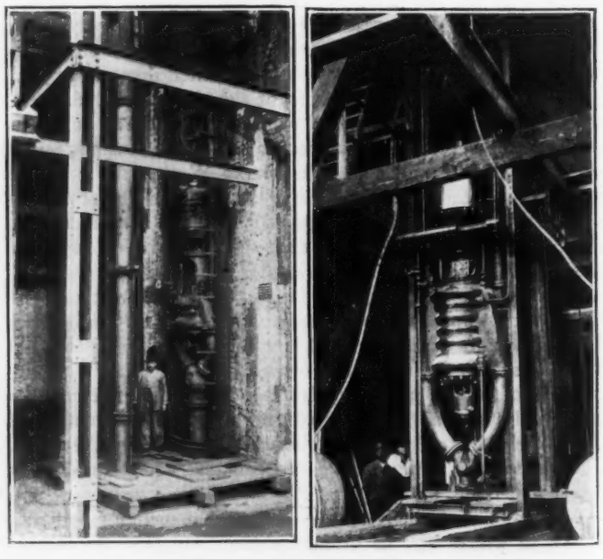
For the smaller-sized equipments 500 volts is usual, while the larger ones are run at higher voltages due to the saving which is obtained by smaller conductors and corresponding cheaper and lighter cable. The highest voltage allowed by the state commission governing mines is 3000 volts. The cable is of the rubber-insulated type with steel armoring, but without lead sheath. The construction is such that it can hang its full length without fastening. Besides the three conductors for the motor the cable contains two light conductors for the thermal contact in the motor. Spare wires are provided for this circuit, as it has been found that these are quite liable to rupture due to their small cross-section. On account of the cable being wound on the drum, all conductors are of the multi-strand type. The conductors for the motor leads are dimensioned on the basis of low current intensity, about 50 per cent of what is allowed for conduit work, as the temperature of the surrounding atmosphere in the shaft is high, and the chance for radiation when wound in layers on the drum is poor. In order to give the cable sufficient mechanical strength cross-sections of less than 50 sq. mm (approximately No. 0 B. & S.) are seldom used. Lighter cables can be used only in shallow mines.

The reel or drum for unwinding the cable is of special design with a diameter of ½ m (approximately 1⅝ ft.), the width depending on the length of cable. The drum is turned by means of a hand crank and reduction gearing with a ratio of five to one. If the cable used hangs its entire length free, the cable drum must have at least triple-reduction gearing and two sets of brakes with two pawls and ratchets in accordance with the requirements of the law. On the opposite side from the manipulating gear are five slip-rings or a five-pin plug and socket for the electrical connection. If the drum is set up in a place where there is liability of weather-damp the slip-rings are immersed in oil.

The other end of the cable terminates in a pothead located near the regulating valve at the upper platform of the pump framework. The pothead is of special design with an ammeter inclosed in a water-tight case, with series transformer if necessary. Besides the ampere scale of the instrument, a second one showing horse-power delivered is also given.

Two gas pipes of sufficient diameter are connected to the bottom of the pothead for protecting the leads to the motor and thermal contact. A single-pole knife-blade switch in a water-tight case is connected to one of the leads to the thermal contact. It is mounted just under the pothead so that it can easily be reached by the attendant on the platform.

Besides the above-described apparatus there are also in an



Figs. 4 and 5—Pump Installations at Aachen, Germany, and Heerlan, Holland, Respectively.

easily accessible position the water purifier for the cooling water, the regulating valves for the different cooling-water circuits and manometers for the suction and delivery heads.

Current is led to the slip-rings of the cable drum from a switch-gear case. These cases are built up entirely of sheet

iron and are totally inclosed so that all electrical conductors are protected from mechanical injury or accidental contact. The dimensions are approximately 3.5 ft. square and 6.5 ft. high. Inside the case is the main switch, which is of the oil-immersed, three-pole, single-throw type, with two inverse time-limit overload relays and one shunt release. It is hand-operated and the operating gear is of the "free-handle" type, consisting of a two-handle operating lever with release trigger, it being impossible to hold the switch in while an overload exists. The overload relays are of the hot-wire type, the time necessary for opening the switch depending on the amount of overload. This style is chosen so that the switch is not unnecessarily opened by a heavy starting current. For the same reason fuses are omitted as they would have to be of such a large size that they would not protect the motor in normal service. It may here be remarked that fuses are much less frequently employed abroad than in the United States, due to the fact that with an overload usually only two fuses blow out and the third causes unbalancing of the system by remaining in, which has had disastrous results in several instances. The action of the relay is to open the shunt or no-voltage release circuit, thereby opening the switch. The auxiliary circuit for the release is suppled with energy by a potential transformer connected across two of the leads. The two conductors of the motor thermal contact are connected to this circuit so that if either the single-pole switch at the motor is opened or the thermal contact fuses the switch is thrown out. Usually a press button is mounted on the front of the case so that the switch may be easily opened from there. In parallel with the release circuit is usually a voltmeter. The circuit is protected from the high-tension circuit by two suitable fuses. In the bottom of the switch case is a stepped switch with contacts immersed in oil, and an operating gear of the lever type with pointer indicating the "off," "starting" and "running" positions. The lever is held in any of these positions by means of a catch. Leads are taken from here to the auto-transformer, which is of the oil-cooled type with taps taken from the middle of the two windings, which are V-connected.

In the starting position the transformer is connected to the line and the motor leads are taken off at points giving a voltage at the motor of half the full value. The motor starts with a torque corresponding to this reduced voltage, and when full speed has been reached the lever is thrown over into the running position, in which the motor is connected directly to the line and the transformer is cut out of the circuit.

Besides this apparatus the switch case also contains three isolating switches and an ammeter with series transformer. The two instruments are placed in the case behind thick plate-glass windows.

A diagram of connections from which the relation of the various apparatus described above may be seen is shown in Fig. 2.

If the cable drum and switch case are placed in an excavation in the side of the shaft, the current is brought in by a three-phase cable of special construction. The conductors are first insulated by a special impregnated paper covering which has a dielectric strength of about 2.5 times that of manila paper. This is then covered with a lead sheath, and this in turn is wound with a jute impregnated covering, which is covered with a steel armoring of rectangular-shaped heavy steel wires. About this is placed another covering of asphalt-impregnated jute to prevent rusting of the armoring. This type of cable is preferable in place of the ordinary armored cable in order to withstand the tensile strain arising from being hung vertically in the shaft. The ordinary steel-strip spiral armoring would pull together, thereby endangering the insulation. If the cable is installed in a shaft in which the water is of acid nature, the cable receives a further coating of tar, which is applied to it after being installed.

The pump equipments, as described above, are used in a large number of mines in Europe, the Siemens-Schuckert Werke alone having installed sixty equipments with a total of 12,035 hp up to April, 1910. It is to be regretted that in this phase of mining the Americans are far behind their foreign competitors. The writer believes that a careful investigation of foreign methods and machinery on the part of American engineers cannot fail to result in greater progress in American mining.

CHROMATIC ABERRATION AND VISUAL ACUITY.

By Louis Bell, Ph.D.

IT was long supposed that by some hocus pocus the refracting system of the human eye was achromatic. Therefore, the eye was not infrequently cited as an example of the infinite superiority of the works of the Creator over the handiwork of man. It remained for Wollaston in the early part of the last century to find out that the media of the eye are dispersive as usual, and that the eye as a whole suffers from chromatic aberration in about the same way as any other refractive system of similar constants. Fortunately the dispersion of the media of the eye is rather small, so that the magnitude of the chromatic aberration is considerably less than would be found, for instance, in a simple glass refracting system of the same focal length. That the result is not more troublesome in ordinary seeing is due to this fact and to the very low luminosity of the extremes of the visible spectrum.

The effect of the chromatic aberration is to make the violet rays come to a focus further to the front than the red rays, while the yellow and green rays take an intermediate position. In focusing by the act of accommodation these intermediate rays of high luminosity are automatically brought into focus on the retina, the red focus lying behind it and the violet focus in front of it. As the writer pointed out some time since in Vol. XLIII of the *Proceedings* of the American Academy of Arts and Sciences, it is only in virtue of a very high maximum point in the luminosity curve of the eye that we are able to see distinctly at all. And it is this same fact which prevents the chromatic aberration being conspicuous under ordinary circumstances. Were the extremes of the spectrum highly luminous there would be no definite focal surface for which accommodation could be adjusted.

Fig. 1 shows the luminosity curve of the eye for uniform distribution of energy in the spectrum, and Curve 2 of this illustration, which shows the luminosity at ordinary intensities, displays the greatly predominant effect of the yellow and green. In point of fact, the difference in refraction between the ends of the spectrum in the eye amounts to about 2 diopters in a total of about fifty-nine, which corresponds to a distance of between 0.5

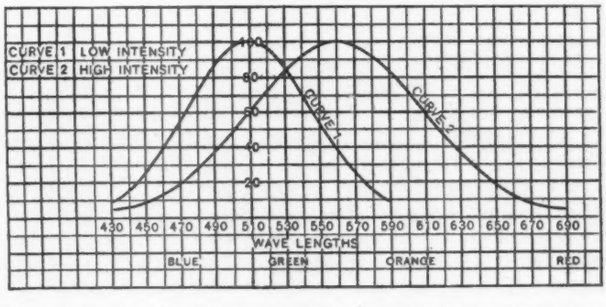


Fig. 1—Luminosity Curves for Uniform Distribution of Energy.

mm and 0.7 mm in the focal surfaces for the red and violet rays. In a structure of so short focal length as the eye this is enough to interfere very seriously with vision, as may be shown by an exceedingly simple experiment described by the writer in the paper just mentioned, as follows:

Procure a piece of very dark paper and a sheet of some vivid reddish-purple tissue. The Dennison violet tissue known as V 5 answers very well. Cut from the tissue a dozen strips about 5 mm wide and gum them upon the dark background leaving spaces between the strips about equal to their width. Examination of this paper with the spectroscope shows that there is strong absorption in the yellow and green, the light

reflected being chiefly from the two ends of the spectrum, hence the grid thus prepared, instead of showing strong luminosity in the usual place, upon which the eye can focus, provides two focal surfaces which nowhere coincide and which differ in position by nearly 0.5 mm. Such a grid when viewed at a distance of from 15 ft. to 20 ft. becomes an indeterminate blur. However, when looked at through a deep-red glass or a bit of gelatine dyed deep red with safranine the blue rays are eliminated and the grid stands out with startling distinctness. A suitable violet screen will produce a similar result, though the observation then requires correcting glasses of somewhere about —1.5 diopter because the violet focal surface lies so far forward of the retina. If the retina were possessed of high sensitiveness for the ends of the spectrum, one would be driven to colored spectacles in order to secure any decent degree of acuity.

In passing it should be mentioned that, as is well known, the sensitiveness changes in low light, the maximum luminosity shifting into the full green, as shown in Curve 1, Fig. 1, hence the focal surface of maximum luminosity in very dim light is pushed forward from the retina and the eye becomes in dim light slightly myopic. This effect is complicated, however, by a slight change of the refracting power of the eye in the same direction owing to the widening of the pupil and the consequent exposure of corneal surface of slightly increased curvature.

A glance at Fig. 1 shows that, while the luminosity curve presents a very strong maximum, the luminosity of the ends of the spectrum cannot be left out of account, and one might reasonably expect a gain in acuity by the suppression of these extreme rays. In other words, the more nearly monochromatic the light effective in forming the retinal image the sharper in general that image must be. Hence in the case of artificial light which is strongly colored, and therefore gives greatly predominant luminosity in a comparatively narrow region of the spectrum, there should be more or less increase in the acuity of vision. Such distribution of luminosity is found in the light of some of the flaming-arc lamps, in that of the mercury-vapor lamps, in the light of the firefly, as has been well shown by Ives and Coblentz in Vol. VI of the *Bulletin* of the Bureau of Standards, and in that displayed by the somewhat similar luminescence due to photogenic bacteria.

The present paper gives some of the results obtained in an investigation of the effect of such reduction of the chromatic aberration on the seeing power of the eye. The luminescent sources just referred to are too faint for investigation under conditions that give normal vision. The light of the flaming-arc lamps, while showing the effect conspicuously, is too subject to fluctuation for easy photometric investigation so that most of the experiments here recorded were performed with the mercury-vapor lamp.

In a strict technical sense the light of the mercury-vapor lamp, like that of the flaming-arc lamp, is far from being monochromatic, but so far as effective luminosity goes the spectrum of the former is perhaps the closest approximation to monochromatism of the light of any commercial illuminant. It consists essentially of four lines, a strong pair in the yellow-green of wave-lengths 579 $\mu\mu$ and 577 $\mu\mu$ respectively, another extremely brilliant line of wave-length 546 $\mu\mu$ and hence of a somewhat fuller green, and a brilliant deep-blue line of wave-length 436 $\mu\mu$.

There are in addition to these a very faint crimson line, a faint blue-green line and a pair of weak lines in the far violet. A rough measurement of the intensity of these lines made with a wedge photometer behind a direct-vision spectroscope using the method of extinction showed that about 90 per cent of the visible light of the mercury-vapor lamp is due to the three brilliant lines close together in the green. Of the remaining small proportion, by far the largest part of the visible light is due to the deep-blue line, which gives the bluish cast apparent in the mercury tube. As has been shown by Sir William Abney in his "Colour Measurement and Mixture," it takes only a very small proportion of strongly colored light to add a perceptible tinge to ordinary white light, and a few per cent admixture of any pronounced color in any combination of colors shifts the apparent hue very materially.

There is a very strong subjective element in our perception of color, which is conspicuous in any attempt to photometer colored lights. This subjective tinge of hue is very striking in using the Lummer-Brodhun photometer, the color being much less conspicuous by itself than when seen in sharp conjunction with the light of an incandescent lamp.

The low luminosity of the blue mercury line leaves the green lines enormously predominant, and in viewing objects illuminated by the mercury-vapor lamp the eye focuses itself with respect to these, which are sufficiently close together to give nearly coincident focal surfaces. In a similar way, in viewing objects illuminated by an ordinary yellow flame-arc lamp the eye focuses for the surfaces determined by the orange-yellow and yellow-green bands, which lie near together in the spectrum and which are responsible for a very large proportion of the light.

In examining the conditions of visual acuity the first task was to determine the relative intensity of the mercury-vapor lamp and the tungsten lamp used as sources of illumination. For this work reliance was placed in the result obtained by the flicker photometer, which seems by general consent the most suitable instrument for direct comparison of lights differing widely in color. The particular form used was a Simmance-Abady flicker instrument, which replaced the usual Lummer-Brodhun screen on the photometer carriage. Tungsten secondary standards varying in rating from 40 watts to 150 watts were kept on the left end of the 2.5-meter photometer bar. At the right-hand end the mercury-vapor lamp or other illuminant was placed above the usual double-mirror arrangement for directing the light along the bar. The mirror factor was checked several times during the investigation and the mirrors were kept scrupulously clean.

The flicker photometer was tested by reversal and was found to reverse with great precision. The ratios found between a 100-watt and a 40-watt tungsten lamp varied on reversal less than 0.4 per cent, an amount within the average error of setting. It then seemed desirable to ascertain whether any idiosyncrasy in the light of the mercury-vapor lamp is troublesome in its measurement with the flicker instrument. Having determined by flicker the ratio between a tungsten standard and the mercury tube in a certain definite position, the following procedure for checking this value was adopted:

After considerable search a green signal glass was found of which a polished disk 2.6 mm thick reduced the tungsten standard to approximately the same apparent color as the mercury arc. This it did by greatly reducing the intensity of the red end of the spectrum, leaving the remainder of the continuous spectrum intact. The next step was the determination of the coefficient of transmission of this screen, using the flicker photometer to ascertain the ratio between a screened and an unscreened tungsten lamp. The coefficient thus obtained, 10.8 per cent, depends then merely upon the comparison by flicker photometer of two tungsten lamps, one of which is screened by green glass, and does not involve the discontinuous spectrum of the mercury light. Finally the screened tungsten lamp was compared directly with the mercury-vapor lamp by means of a Lummer-Brodhun screen, a comparison extremely easy to make on account of the close similarity in color. There was thus obtained a value for the candle-power of the tube in nowise depending on the suitability of the flicker photometer for measuring the tube. The value found for the candle-power of the tube in this way varied by a trifle less than 1 per cent only from that determined by direct comparison of the tungsten standard and tube by means of the flicker photometer. It is, therefore, evident that, at least under the conditions of its use here, the flicker photometer furnishes as valid a comparison between a tungsten lamp and a mercury tube as it does in ordinary heterochromatic photometry.

For the acuity measurement the first device employed was the acuity wedge, shown in Fig. 2. Here *BB* indicates the photom-

eter bar. The photometer head was removed from the carriage and in its place was set a 60-deg. wooden prism about 5 cm on a side and about 15 cm in height, with its rear face parallel with the photometer bar. Perforated screens limited the direct beams of light so that they fell fairly upon the sides of the wedge. These screens were continued in the front by another

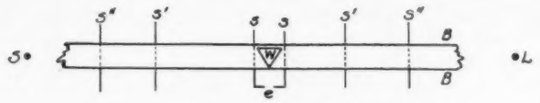


Fig. 2—Arrangement of Acuity Wedge.

dead-black screen with an aperture *e*, about 20 mm wide and 50 mm high, through which the observer looked toward the forward angle of the prism, the eye being placed at convenient reading distance in front of the slit *e*. The ordinary sliding velvet screens *s'* and *s''* screened the light from the observer as usual. A standard tungsten lamp was placed at *S* and the mercury lamp in its customary position at *L*. Over the two front faces of the prism were then drawn tightly two parallel columns of printed matter, black on white with identical sizes of type. Then, looking through *e*, the observer balanced for equality the distinctness, shifting the wedge back and forth until a point was found where the paragraphs were equally legible on the two sides of the wedge. This particular proceeding was adopted to get the equivalent of a null method in the acuity measurement and to take advantage of a rapidly varying function of acuity—that is, the illumination—as the thing to be measured. The printed matter used varied over the ordinary sizes of book and newspaper type, the first thing used being a double column from the editorial pages of the *Engineering Record*. Afterward some small-type paragraphs from the same journal were tried, but most of the experiments were made with the standard test type of the American Ophthalmological Society, advantageous on account of its unfamiliarity.

Five observers participated in these acuity tests, all of them being experienced in photometry. Settings for equal acuity proved to be more consistent for any one observer than would have seemed at first sight probable. A typical set of readings, neither better nor worse than most, is here given.

J.	J.
129.6	135.4
137.7	130.6
136.4	128.9
132.9	130.1
128.9	134.4

The readings are in centimeters from the standard lamp on the photometer bar. There were considerable variations, as might be expected, in the average results reached by the several observers. Particular care was exercised to see that the obserers got no clue as to where a balance had been found by the others. At least three of the five had no knowledge of the results being reached, and before calling each of them in to observe the carriage was shoved into an entirely impossible position. The ratios between the mercury lamp and the incandescent standard thus found by the five observers were as follows: B, 9.00; K, 8.04; J, 10.25; G, 12.9; W, 12.65.

Now, the real ratio between the luminous intensities as determined in the manner already described was 1:5.42. The apparent candle-power of the tube as determined by equal ease of reading was, therefore, on the average 1.95 times the actual photometric candle-power. This quantity, therefore, measures the difference in acuity sought. It should here be added that the actual intensity of the illumination on the type in these measurements ranged from about 15 meter-candles to 20 meter-candles on the tungsten side.

There was a marked sense of sharper definition on the side of the mercury tube and several of the observers could only be persuaded by careful inspection that the type on this side was not actually larger than that on the other. There was also a perceptible added strain on the accommodation on the side of the tungsten lamp in making these judgments of acuity, the comparatively slight difference in focus being at once obvious.

To get, if possible, a still closer estimate of the effect of the quasi-monochromatic mercury light on acuity a second series of experiments was conducted with a modified acuity photometer. This is shown in diagram in Fig. 3, where, as before, *BB* are the photometer bars, and *s*, *s'*, *s''* the usual screens. Instead of the prism, however, a table 15 cm square was placed upon the photometer carriage. At *b* a vertical plate with clips to retain the target was placed. A vertical blackened brass septum *c* projected forward nearly to the axis of the photometer bar and served to separate the two halves of the target while presenting merely a thin black edge to the eye. Two mirrors, 5 cm x 8 cm, were then placed on adjustable bases at *dd*. The light from the two sources to be compared fell upon these mirrors, and illuminated the target at *b* at nearly normal incidence. Between the inner edge of the mirrors is left an opening about 4 cm wide through which the target could be observed. Two rods *ff*, sliding under the table, carried a blackened plate *g* with an eye-hole fitted with three adjustable diaphragms, 3 mm, 5 mm and 8 mm in diameter respectively. Just in front of the eye-hole was a support for carrying auxiliary lenses when these were used. At *e* another adjustable support carried a lens split on the vertical diameter, the right hand being plain glass, the left-hand half of +0.25 diopter. This lens was used in many of the subsequent experiments to eliminate the difference in focus between the two sides of the target already referred to. With this apparatus experiments were carried out with the smaller test type of the American Ophthalmological Society, but chiefly with the wavy dotted lines of the target shown in Fig. 4. This choice was the result of many experiments in acuity targets presenting relatively high sensibility without involving the reading of sentences which might become more or less familiar. The diagram shown in Fig. 4 was printed in black on white, in white on black, and also in black and in white on numerous colors from deep reds through the spectrum to violets. The wavy dotted lines gave on the whole more definite settings than did the paragraphs previously used and gave also better agreement between the several observers. The readings, for instance, obtained by observer J ran as follows: 131.7, 129.2, 125.0, 125.6, 123.5, 123.5, 126.7, 125.4, 128.8, 128.5, and the results obtained for the ratio between the lamps by the five observers were as follows. Black on white—B, 9.74; K, 9.62; W. 9.37; J, 9.89; G, 10.10. From these readings the mean apparent candle-power of the tube was 1.76 times the actual photometric candle-power, the intensity of illumination on the tungsten side being of the same order as before. As a check on this a precisely similar target with white lines on black was tried and four observers obtained on it the following ratios: B, 9.02; W, 7.76; J, 9.66; G, 9.95, showing again increased acuity on the side of the quasi-monochromatic light of quite the same order of magnitude as before.

Some experiments were made on a yellow flaming-arc lamp,

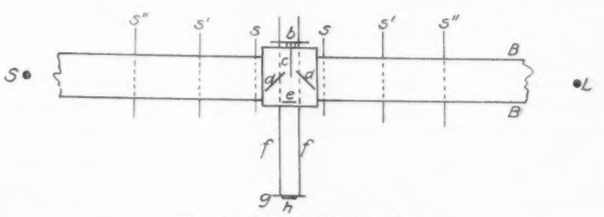


Fig. 3—Acuity Photometer.

with the result of obtaining qualitatively the same impression of increased sharpness as with the mercury-tube lamp. The fluctuations in the light, however, were too great to permit of coherent settings, although there was no doubt as to the nature of the phenomenon. The experiment gave useful information as to the character of the phenomenon dealt with, since

the effective luminosity of the flame-arc lamp lies fairly near to that of the tungsten lamp instead of being materially displaced into the green, as with the mercury-tube lamp. Hence the increased acuity must be chiefly, if not entirely, due to the monochromatic character of the light rather than to the difference in color. Theoretically, as was shown by Lord Rayleigh years ago, the resolving power of any dioptric system increases as the wave-length of the light decreases, a fact often taken advantage of in photomicrography, and, therefore, one might have enhanced acuity with a greenish light, since Lord Rayleigh's theory applies to the human eye. The experiment with the flame-arc lamp, however, showed that this factor in the case is at least not conspicuous, so that the results seem to be due simply to lessened chromatic aberration. The intensities at which the observations were made preclude any material effect due to Purkinje's phenomenon. The conditions also included extreme contrast, so that the effect of variations in Fechner's fraction may also be left out of account. One must therefore conclude that the quasi-monochromatic light of the mercury-tube lamp and other nearly monochromatic sources actually does give at ordinary reading distances, such as those here taken, materially increased acuity for details in white on black or black on white. Such a monochromatic source shows, as judged by acuity measurements, roughly from one and one-half to two times its real photometric value, when compared with light of continuous spectrum derived from ordinary incandescence.

The experimental fact certainly is that the nearly monochromatic source enables equal acuity to be attained at an illumination much lower than is necessary in the case of the

Fig. 4—Testing Target.

light of the continuous spectrum in about the proportion stated. This does not, of course, imply that the visual acuity rated according to Snellen's scale varies in this ratio. Reduced to Snellen's scale, on the basis of König's data, as given in *Sitzungsber. Berl. Akad.* 1897, 559, the change in acuity would be equivalent to something like a change from 5/5 to 6/5 or 5/4. How far this same difference would hold for a monochromatic source of violet or deep red remains to be seen, and the writer hopes later to look into this matter. Nor do these experiments include tests of the relation between illumination and acuity for distant vision, in which, as Dow has shown in an article in the *Illuminating Engineer* (London, Vol. II, page 233, etc.), the power of the eye to focus light of different colors changes radically from the conditions of near vision. This fact, indeed, has already been mentioned in considering the visibility of the violet grid as a test of chromatic aberration. Dow's experiments, like those here cited, indicate that the blue-green end of the spectrum is advantageous for near vision. Ashe, as shown in an article in the *Electrical World* of Feb. 25, 1909, finds also an advantage in acuity belonging to the shorter wave-lengths at moderate distances. Dr. Stuhr, working under the direction of Prof. L. Weber at Kiel, as shown in an article in the *Illuminating Engineer* (London, Vol. II, page 345), finds also a similar gain in acuity as one passes away from the red end of the spectrum. The results of these investigations would appear to show the actual application of Rayleigh's theorem to vision, but how far this was complicated by the effect of chromatic aberration one cannot say without knowing precisely the kinds of red, green and blue light used in them.

The only other recent investigation of acuity by lights of different kinds is the very interesting research of Broca and Laporte recorded in the *Bull. Soc. Int. des Electriciens*, June, 1908. These experienced investigators found no material difference in acuity between any commercial illuminants due to color, even as between the light of the mercury-arc lamp and that of an incandescent lamp, and their results are therefore apparently at variance with the results here recorded and the results of the investigations just quoted. The explanation of the results of Broca and Laporte is, however, an extremely simple one. In their experiments they first adjusted the reading photometer to apparent equality of brightness and then, leaving the target in that position, measured the acuity. They were, therefore, in about the condition which would have been reached in the experiments here recorded if the wedge *w* in Fig. 2 had been adjusted to equality of apparent brightness and acuity comparisons had then been instituted. To test this matter four of the observers made careful settings of the wedge for luminosity balance, when covered with plain white paper. The results were as follows: B, 8.41; K, 6.86; J, 10.93; G, 10.1. The balance thus reached is of the same order as that found for the balance by acuity, the comparison in each case being between the tungsten lamp and the mercury-tube lamp. In other words, Broca and Laporte practically eliminated their difference of acuity by their balance for apparent brightness. This same source of error has been pointed out by Ashe. Had Broca and Laporte established equality of brightness for their target by the flicker photometer, or even by an equality-of-brightness photometer used in the way indicated by Ives in an article in the *Transactions* of the Illuminating Engineering Society (Vol. V, page 711), they could not well have missed finding a difference in acuity. It should here be pointed out that the results obtained, both by the writer and by Broca and Laporte, by the equality-of-brightness method are not in the least in contravention of the work of Ives here quoted, since that investigator merely shows that under particular conditions even with considerable color difference the equality-of-brightness method and the flicker method may give substantially coincident results, while he emphasizes the decided superiority of the flicker instrument for heterochromatic photometry on the score of its much greater sensibility and ease of setting. In general, the flicker photometer does not agree with contrast comparisons which vary in the direction here found.

The writer's experiments merely make it apparent that a nearly monochromatic light has, through its great reduction of chromatic aberration, a power of revealing detail considerably greater than its photometric intensity would indicate. It acts as if it were a light of much higher candle-power than it really is. In fact, the assumption that the gain in acuity is due to a real difference in candle-power instead of the spurious difference indicated by the equality-of-brightness comparison would lead to an efficiency of light production in the mercury tube which is, in the writer's judgment, quite inadmissible. Unless the flicker photometer, contrary to all the investigations that have been made of it, is wholly untrustworthy, this difference is due chiefly to the large decrease in chromatic aberration. If one were to take the other horn of the dilemma he would have to credit the mercury arc and the yellow flaming arc with truly prodigious light-giving efficiency. There is no reason, however, to distrust the correctness of the results reached by the flicker method, particularly in view of the researches of Ives.

The writer desires here to express his deep obligation to Dr. Charles H. Williams for most efficient assistance in planning and carrying out the tests here recorded.

THE THREE-TRANSFORMER METHOD OF CHANGING FROM TWO TO THREE PHASES.

By F. T. WYMAN.

The method in common use for changing from two phases to three phases, or the reverse, is one involving the use of two transformers with either the secondaries or primaries T-connected. In this method, which is illustrated in Fig. 1, the voltages are subject to distortion not only when the secondary loads are unbalanced, but also under balanced non-inductive loads. If one of the transformers becomes inoperative, then only one phase remains active on either the three-phase or the two-phase side, so that the whole system is out of commission until a new transformer can be installed. Consequently, in order to insure continuity of service a spare transformer must be continually carried in stock.

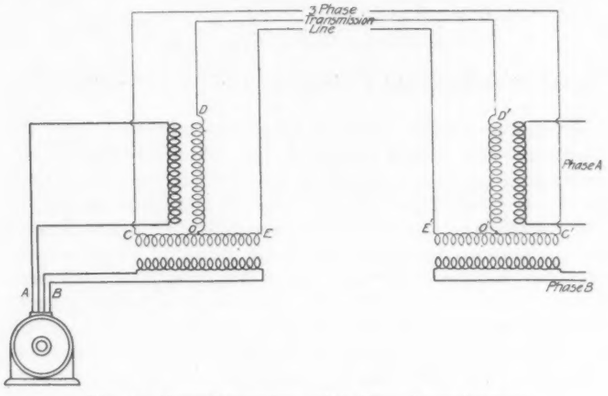


Fig. 1—Transformation with Two Transformers.

A three-transformer method of obtaining the same results, which seems to possess some merits, although it has not been applied practically to any great extent, is shown in Fig. 2. The transformers are shown Δ-connected on both the primary and secondary sides, although the transmission-line side can be either Δ-connected or Y-connected as the requirements of transmission demand, and the neutral of the Y-connected system may be grounded if desired.

In comparison with the two-transformer method, the three-transformer method possesses the advantage of allowing the two-phase voltages to be obtained from the same transformer coils connected for and delivering three-phase voltages; however, the two-phase voltages are not equal in value to the three-phase voltages, and the ratio is not a convenient one, being 1.00-to-0.866 = 1.155-to-1.00.

If one of the transformers in the three-transformer system should become inoperative, then the two remaining ones can immediately be temporarily V-connected and carry the load until the other is repaired, thus avoiding the necessity of carrying a spare transformer in stock. When a spare transformer is kept in stock its rating is only two-thirds as great as a spare transformer for a two-transformer scheme.

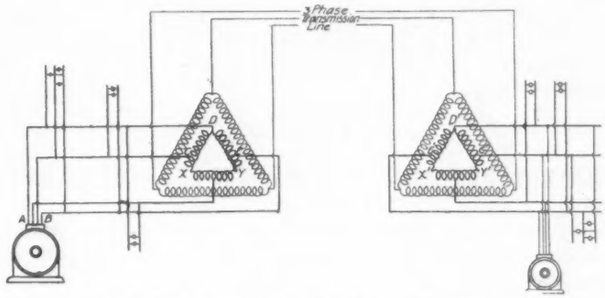


Fig. 2—Transformation with Three Transformers.

The three-transformer scheme possesses a disadvantage as compared with the two-transformer scheme in that "interconnected" two-phase generators or motors cannot be used, as destructive local currents would be produced in the windings. It is superior to the two-transformer scheme in its greater freedom from unbalancing of voltage and larger factor of safety for continuity of service.

Central Station
Management, Policies and Commercial Methods

ELECTRIC-APPLIANCE DEMONSTRATIONS FOR THEATER PATRONS.

The new offices of the Union Electric Light & Power Company of St. Louis share a building with the Shubert Theater in that city, and the sales and demonstration rooms of the electric company adjoin on either side, and can be entered from the theater lobby. The demonstration room is kept open evenings until after theater hours, and provides a pleasant reception room for theater patrons, both before and after the performance. Persons waiting for friends, carriages, etc., are invited to step into the electrical reception room, where electric household heating and motor devices, fixtures and even an electric automobile are exhibited. The room is invitingly arranged, and is comfortably equipped with chairs and writing tables. Visitors show a lively interest in the electric appliances, and a number of good sales have been traced to these demonstrations, which secure the attention of a good class of people. At 1:30 Wednesday and Saturday afternoons, the matinee days, a dainty electrically cooked luncheon is served to visitors. Creamed asparagus on toast and percolator coffee is a sample menu, the offering being varied in various simple combinations. Ladies display much interest in the operation and results obtained with electric cooking devices, and frequently order appliances for their own use.

LIABILITY FROM FAILURE TO HAVE WIRES INSULATED.

A verdict of $5,000 against a light and power company was the result of the company's failure to have its wires properly insulated at a point where they crossed a public street, in a recent decision of the Kansas Supreme Court (Winegarner vs. Edison Light & Power Company). The action was brought to recover damages for the death of the employee of a house mover in the city of Wichita, Kan. His principal duty was the driving of a team to convey materials used in house-moving operations. When not so engaged it was his duty to assist in any way in the business, and he was accustomed to handle electric wires when it became necessary to do so in moving buildings under them. In accordance with the requirements of the ordinances of Wichita a permit had been obtained from the city clerk for the moving of a certain building. The house mover the day before the work was to be done had given notice to the electric light company of his intention to move the building, and the employees of the company next morning removed the wires near the building and remained in the neighborhood, subject to call in case they were needed. The building was moved along the street to a point where other wires of the company crossed it, strung at a height of about 20 ft. The comb of the roof was higher than the wires, and

the wires were raised by the house mover. The building stopped after the wires had been partly passed. The mover did not call upon the electric company's men to handle the wires, but testified that he intended to attend to them himself. He was detained, however, in talking to a man who sought to engage his services, and the employee, being disengaged at the time, climbed upon the roof, evidently to attend to the wires. In some way he came in contact with the wires, which were uninsulated, and was immediately killed. It was not shown that the electric light company had actual notice that the house was to be moved past the place where the accident occurred. It was held, nevertheless, that the company was bound to have its wires crossing streets so insulated as not to be dangerous to persons coming in contact with them. In other words, the company was bound to know that houses are occasionally moved under its wires and to make proper provision against accident, and was not entitled to be notified whenever such an operation was to take place.

EMERGENCY LINE AUTO WITH SEARCH LAMPS.

An emergency repair automobile in use by the line department of the Cincinnati Union Gas & Electric Company is equipped with a pair of powerful search lamps which render valuable service in illuminating pole tops or other places where rush repair jobs must be done after nightfall. The 8-in. reflector search lamps are supplied with acetylene gas from a compressed-gas storage tank carried on the car, and the lamps are mounted on trunnions so that they may be turned to throw their beams in any direction required. The repair automobile also carries an emergency repair tool-box, and has everything aboard necessary to make ordinary line repairs. When a hurry-up call is received at the garage where the car is stabled, the machine is first run by the homes of the men who will be needed on the job. After picking these up, no time is lost in getting to the scene of the trouble, for the car is a speedy one. For protection against wet weather the seats for the linemen are covered. In case it becomes necessary to replace some piece of line apparatus the car can be dispatched back to the storeroom for it, with the minimum delay to those on the job.

CORPORATION REGULATION IN OKLAHOMA.

The electric-light companies operating in Oklahoma enjoy —or rather suffer—a degree of regulation by the local State Corporation Commission which is probably unequaled in any other state in the Union. Much of the power of the Oklahoma commission, however, is manifested in instructions for the companies to make out numerous and lengthy reports, question blanks, etc. The monthly report sheet which every public-service corporation must file with the commission comprises a large tabulated page analyzing operating expenses and receipts according to the commission's approved system of uniform accounting. This system divides company accounts under forty-two headings, eight pertaining to plant revenue and income, six to operating expenses, four to plant maintenance, eleven to accounts, etc., and thirteen to general expenses.

The blank for the annual report is a weighty 9-in. x 11-in. book of thirty-six pages, having about fifty lines per page. These are taken up with questions, answer spaces, tabular spaces, etc., totaling over 1000 entries if all questions are answered as required. As may be surmised, some of the questions asked are very searching. One inquires details of all options, etc., held by the respondent company; another requires that there be set down the affiliations, connections, etc., with any other corporations of each and all directors, officers, etc., of the respondent company. The proper answering of this mass of queries involves much onerous labor, which, of course, falls most heavily on the small-plant manager. One company in a town of 8000 population by employing an expert accountant familiar with its books and with the commission report form was able to have its report completed after four days of continuous hard work by the expert. A small-plant manager who worried along alone might require a month of spare time to complete such a report. The blanks are sent out July 1 and must be returned properly filled by Oct. 10. In addition to the last report there was appended a list of fifty-seven questions, each 100 to 150 words in length, and covering a broad and unique range of inquiries. Failure to comply with the Oklahoma commission's instruction involves a fine of $500 a day, each day's delay constituting a new offense.

ORGANIZATION CHANGES IN CHICAGO COMPANIES.

An executive order issued by President Samuel Insull, of the Commonwealth Edison Company, Chicago, makes some interesting changes in the operating and engineering departments of that company. The effect of these changes is to extend the general scope of the engineering department, which is located in the Market Street building, three floors of which will be necessary for the accommodation of this department. All engineering work for the underground system, heretofore done by the street department, and all work for the overhead system and on customers' premises, heretofore done by the inspection department, and all illuminating engineering have been grouped as a division of the electrical engineering department. Mr. H. B. Gear has been appointed engineer of distribution in charge of this division of the engineering department, with Mr. P. F. Williams as assistant. The engineer of distribution reports to the electrical engineer, Mr. R. F. Schuchardt. The position of general inspector is abolished, and all work in connection with installation and renewal of incandescent lamps is placed under the general charge of the chief operating engineer, Mr. W. L. Abbott.

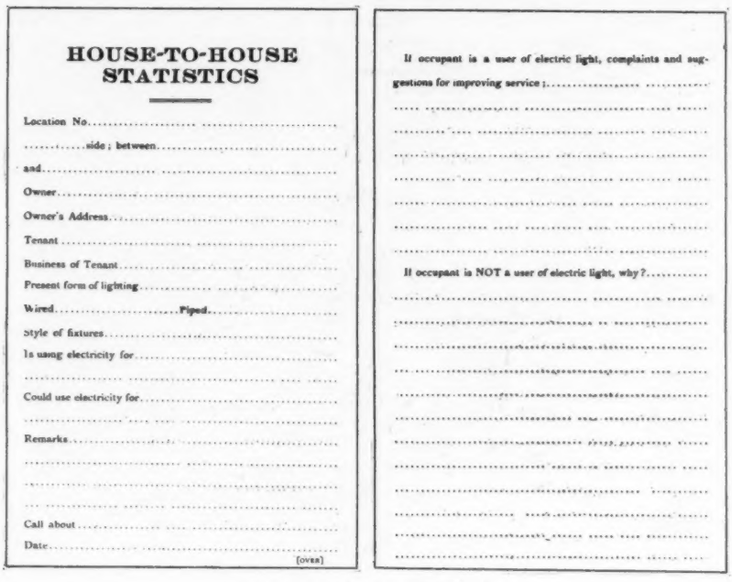
Owing to general expansion of the business and increase in load it has become necessary to divide the territory of the North Shore Electric Company surrounding Chicago into three operating divisions, each in charge of a chief operator. These divisions are known as the north, west and south divisions. The north division will include the territory north of an east-and-west line coincident with the northern limits of Chicago. The south division will include the company's territory lying south of an east-and-west line coincident with the center of Seventy-ninth Street, Chicago. The west division will include the portion of the company's territory west of Chicago between the north and south divisions. The division chief operators will be held responsible for the electrical service in their divisions. They will report to the mechanical engineer, Mr. J. L. Hecht.

HOUSE-TO-HOUSE CANVASS AT HAMILTON, ONT.

Like most other public-service corporations, the Hamilton Electric Light & Power Company, Limited, has had its share of complaints, which, while not more than ordinary, nevertheless meant dissatisfied customers and the possibility of their becoming users of other commodities, such as natural gas, selling at 45 cents, or artificial gas, selling at $1 per 1000 cu. ft. To get at the bottom of these complaints a house-to-house campaign was decided upon because by this means the company could get in touch with the tenants of every house, flat, etc., where electricity could be used, ascertain the grievances of its present customers, and in addition find out why tenants were using other commodities in preference to electricity.

Six men were considered a large enough staff for the work of canvassing Hamilton with its 75,000 population, and these were thoroughly informed on the company's policy, etc. For the first few days the men stayed out only a few hours and the rest of the day was given over to sessions in which the complaints and questions (out of the ordinary) each man had received were discussed. In addition to special calling cards the canvassers were furnished with report blanks and a special

number of the company's monthly publication, *The Electrical Bulletin*, which, in addition to short articles on complaints and co-operation, had information regarding rates. The canvassers in all their calls dealt directly with the man or woman of the



HOUSE-TO-HOUSE STATISTICS

Location No.....
.....side; between.....
and.....
Owner.....
Owner's Address.....
Tenant.....
Business of Tenant.....
Present form of lighting.....
Wired.....Piped.....
Style of fixtures.....
Is using electricity for.....
.....
Could use electricity for.....
.....
Remarks.....
.....
.....
.....
Call about.....
Date.....
(over)

If occupant is a user of electric light, complaints and suggestions for improving service.....

If occupant is NOT a user of electric light, why?.....

Canvassers' Report Blank.

house, and not with servants, housekeepers, etc. This oftentimes necessitated an extra call or a trip to the office of the man of the house. The blanks explain themselves. Strange as it may seem, it is not a custom in Hamilton for a landlord to wire his house and supply the fixtures, or if he does wire the house he seldom furnishes the fixtures. In many instances a tenant will wire (concealed) the house and furnish the fixtures or drop cords, and when he vacates the premises remove the fixtures or sell them to the incoming tenant. In other cases a tenant will wire (open work) the house and furnish his own drop cords or fixtures, and then when he moves out he either sells or removes everything.

RECAPITULATION OF 1096 CALLS MADE IN ONE WEEK BY SIX CANVASSERS.

Houses wired, piped, etc.	
Wired only	184
Piped only	316
Wired and piped	320
Neither wired nor piped	276
Illuminant used.	
Electricity	369
Gas	400
Oil	327
Reason 727 tenants are not using electricity.	
Not wired	309
Afraid of electric light	6
Not wired—too expensive	98
Wired—too expensive	65
Not wired—satisfied with gas	188
Wired—satisfied with gas	37
May move out, not decided to stay	18
Wired—no fixtures	6
Complaints of 369 tenants.	
None	326
Accounts somewhat high	18
Accounts very high	20
Meter not read right	1
Objects to meter rent	1
Meter does not register right	1
Lighting dim	2

A few days after the campaign started newspaper reporters were apprised of the fact, with the result that the issues of that day contained front-page articles on the efforts the company was making to satisfy all its customers, etc. A week later further newspaper articles told how the campaign was progressing. This publicity helped the men considerably in their work and was good advertising. The canvass worked out well and the canvassers, although they made only the one call, closed contracts daily and turned in good prospects which regular men followed up to advantage. From thirty-five to forty calls were made a day. This may seem many as compared to a regular canvasser's visits, yet when it is considered that they were purely missionary calls it will be appreciated that the work was not unduly rushed. When calling on customers the men endeavored to place irons, etc., and turned in numerous applications for irons and toasters on trial as well as many inquiries for other articles, such as vacuum cleaners.

The reports as turned in by the men were gone over daily and the data transferred to a regular follow-up system, filed according to street and number. Memoranda of prospects needing immediate attention were given to the company's regular canvassers for further attention. The information with reference to those residents not using electric light was filed and followed up subsequently with advertising matter.

The complaints of customers were given special attention. A letter was immediately sent to the customer stating that a representative had reported his complaint and that it would receive immediate attention. The complaint was then turned over to the proper department and thoroughly investigated. Where the complaint was based on a high bill the meter was either tested or changed, as seemed advisable. Blackened lamps were changed and smaller candle-power carbon and tungsten lamps were substituted in places. A letter was then sent giving the results of the investigation and stating what had been done to improve the service, etc. Other complaints were looked after in the same thorough manner, as it was realized that if complaints are made and not properly investigated it works against the company.

By investigating the different complaints and improving the service in some places the company made many good friends and found that taken altogether the house-to-house canvass with prompt attention to complaints was the best advertising.

STREET RAILWAY CHANGES FREQUENCY TO MAKE STANDBY SERVICE AVAILABLE.

In adding 2500 kw additional steam-turbine equipment to its generating station, where a 1500-kw engine and a 1500-kw steam turbine are now in use, both driving 25-cycle generators, the Oklahoma City Railway Company has chosen to install 60-cycle equipment, making its alternating-current system available for interconnection with that of the 8600-kw plant of the Oklahoma Gas & Electric Company in case of emergency. To this end it was first decided to re-equip the entire plant for 60-cycle generation, but it was later concluded to continue operating the Westinghouse-Parsons 1500-kw, 25-cycle turbine set, running the two turbines of different frequencies as entirely separate plants but paralleled on the 550-volt direct-current side of the rotary-converter and motor-generator sets. The engine-driven unit will be held in reserve.

On account of the characteristics of 60-cycle rotary converters, motor-generator sets have been installed at Oklahoma City to convert the 6600-volt, 60-cycle energy into direct current for the trolley circuits. Six 500-kw synchronous motor-generator sets are being used, two of which will be installed at the power plant and four at the substation. Two of these units are equipped with 100-kw booster generators, making them virtually three-unit machines. The new equipment, which was furnished through the Oklahoma City office of the General Electric Company of Texas, also includes a 1000-kw transformer for the transmission line to the substation and a new switchboard. The interchangeability thus possible between the generating systems of the street railway and central station companies obtained by the change to 60 cycles lends stability of course to either system in case of interruption or breakdown of its power plant.

EFFECT OF WEATHER ON LIGHTING BILLS.

The accompanying illustration shows part of an ingenious weather chart which is used by the New York Edison Company. The full chart presents graphically the number of clear and rainy days for a series of three years, arranged so that anyone can see at a glance where there has been greater call for artificial light this year as compared with the two years preceding. This graphic statement is sent out by the New York Edison Company to its patrons whenever bad weather during the past month will necessarily have caused an increase of the customers' bills. For instance, the chart recently sent out shows that, whereas for the first quarter of 1910 there was 62 per cent of clear weather in comparison with 38 per cent of dark days, for the same months in 1911 the amount of bad weather was noticeably greater. This method is a part of the New York Edison Company's efforts to keep its customers informed on their own lighting conditions and to maintain the friendliest possible relations with users of its service.

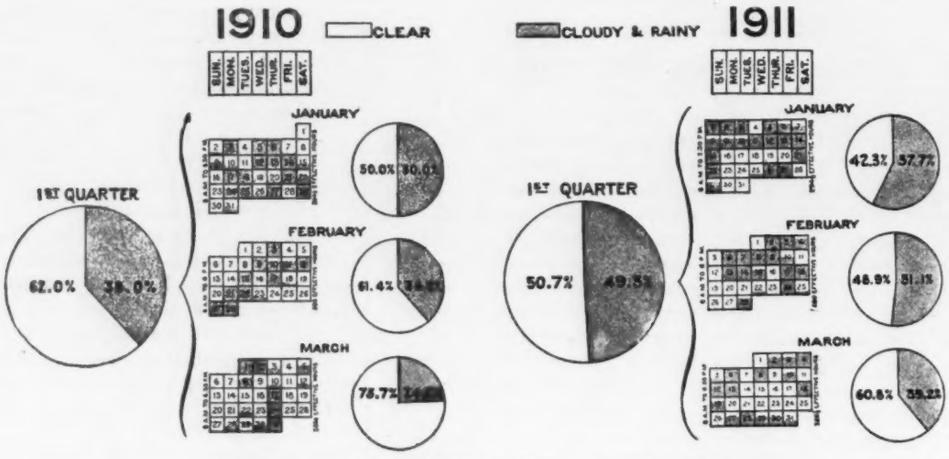


Chart Showing Percentage of Clear and Rainy Days.

CENTRAL-STATION DRIVE IN A PAINT FACTORY.

A motor load like that of a paint factory, which is made up of many long-hour grinding operations, is desirable business for the central-station company as well as the customer. The latter avoids the trouble and upkeep of an isolated plant, and enjoys the advantage of operating any part of his factory overtime without the expense of running the whole power plant. On the other hand, the continuous grinding and mixing processes involved in paint-making insure a good load-factor for the central-station's service.

The factory of the Peaslee-Gaulbert Company, paint maker, Louisville, Ky., has been recently converted to central-station service from its former operation by isolated-plant power. There was originally installed a 250-hp Skinner engine, direct-connected to drive a 125-kw, 220-volt direct-current generator at 200 r.p.m. Steam was generated in a battery of two Vogt boilers, equipped with automatic stokers. For a small plant the installation was a model one in every respect. Besides the lighting, this plant supplied energy for nearly 200 hp in 220-volt direct-current motors used to drive various machines in the paint factory. When central-station service from the lines of the Louisville Lighting Company was determined upon it was decided, rather than to re-equip the factory with alternating-current motors, simply to replace the old prime-mover unit by a synchronous motor-generator set, which by field adjustment could be made to take a leading current and thus improve the line power-factor. Accordingly a 135-hp, 2200-volt, two-phase self-starting synchronous motor, with self-contained exciter, was arranged to drive a 220-volt direct-current generator at 900 r.p.m. By increasing the field excitation of this synchronous motor it can be made to take a 20-per-cent leading current, which is of benefit to the central station in offsetting the lagging power-factors of other induction-motor loads. The steam-boiler equipment is now run at a reduced pressure to supply steam for heating the factory only, and the engine-driven set has been set aside preparatory to taking down.

In a paint factory of this kind advantage is taken of gravity routing to convey the products under process of manufacture from one machine to another, the raw material starting on the top floor and finding its way down, story by story, until at the bottom it is ready for kegging. The crude stock is delivered to the factory from cars on the company's private switch tracks and raised by two 10-hp electric elevators to the desired floor level. Liquids are lifted to storage tanks on the top floor by means of a 12-in. motor-driven centrifugal pump, oils, varnishes, turpentine and other materials being handled successively by the same pump.

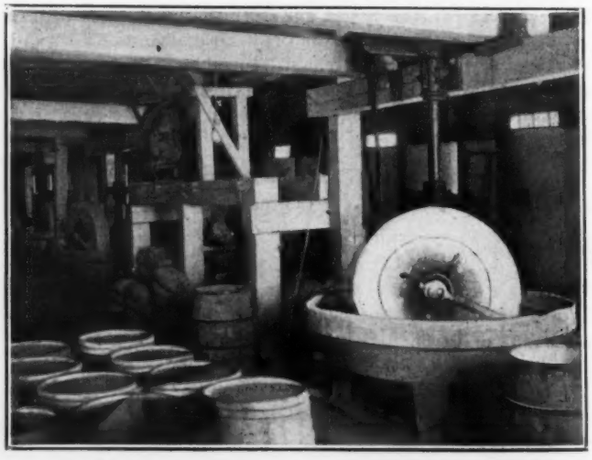


Fig. 1—Motor-Driven "Chasers" for Mixing Paint Ingredients.

On the top story the dry ingredients of the paint body, with the necessary oils, driers, etc., are thoroughly mixed together by the great motor-driven "chasers" shown in Fig. 1. These chasers consist of large circular pans around which huge solid-iron wheels and paddles slowly rotate. These machines accomplish thorough mixing of the paint ingredients before the latter are delivered to the grinding mills below. One 25-hp slow-speed motor, geared to a horizontal shaft, drives five such

72-in. chasers, the vertical shaft about which the wheel revolves turning at the rate of about 14 r.p.m. Clutches are arranged so that any chaser can be started or stopped without interfering with the operation of the others.

In a second type of paint-mixing chaser, shown in Fig. 2,

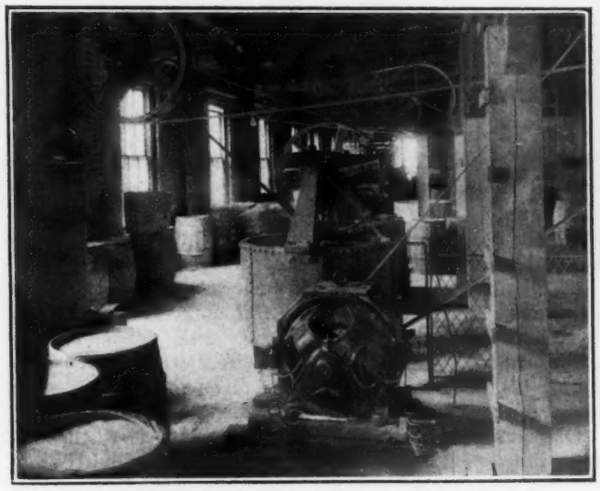


Fig. 2—Motor Operation of Steam-Jacketed Tub-Type Mixers.

rotating paddles are relied on to effect a thorough incorporation of the paint ingredients. The arrangement of the paddles or rakes is such that the material is continually worked over from the top and bottom of the pans. Some of these mixers are steam-jacketed, keeping the material warm during manipulation. The 22-hp motor, belted to a line shaft, as shown in Fig. 2, drives four 48-in. and six floor-type mixers, which are used for compounding special batch mixtures.

From the mixing floor the paint material drops through gates to the grinding machines on the story below. These grinders are of three types—roller mills, burr or stone mills and iron mills. In the roller mills three 14-in. rollers, geared to revolve at increasing speeds from the first to the third, are mounted in a row. In passing between either pair of rolls, one member of which is revolving at higher speed than the other, a combined crushing and grinding action is given the paint material. This grinding is further effected by arranging one or more of the rolls with a cam motion to give a sidewise movement, which also aids in distributing the material on the rolls. Several roller mills are shown at the right in Fig. 3. In the burr

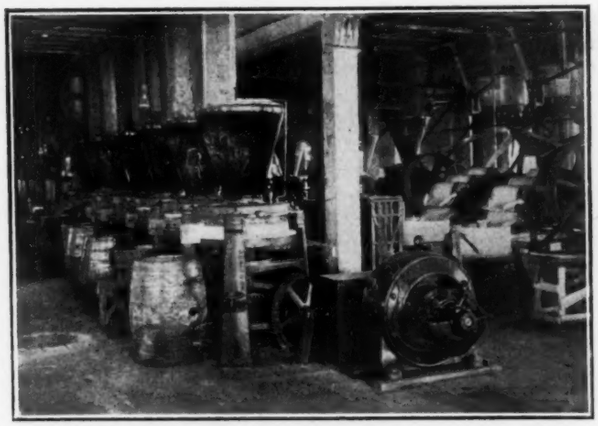


Fig. 3—Burr Mills and Roller Mills for Grinding Paint Bodies.

and iron mills flat grinding surfaces of stone-to-stone or metal-to-metal, as the case may be, reduce the material to a finely ground condition. A row of burr mills is shown at the left in Fig. 3. In the case of both the burr and roller mills in the picture, it will be clearly seen how the raw material is supplied to the mills from the mixers above, while the ground product is passed on to the floor below or in the case of special batches which are to be kegged without ready-mixing it is collected in containers. By means of a line shaft one 20-hp motor drives six roller-mill units and also six burr mills. A 20-hp motor on the same floor drives four 30-in. burr mills and three 20-in. mills. A 20-hp motor installed on the floor below, where

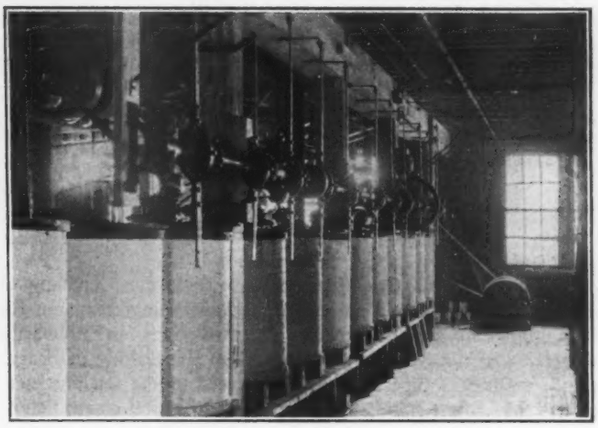


Fig. 4—Mixing Tanks for Preparing Ready-Mixed Paints.

it drives a number of color mixers, is also belted up to a shaft on the grinder floor and operates five 20-in., two 18-in. and eleven 15-in. burr mills, and eleven 12-in. iron mills.

After being thoroughly ground, if the paint body is to be made up into ready-mixed goods, it is dropped from the grinding mills into great mixing tanks on the floor below, where the liquid solvents are added and the whole mass thoroughly stirred into intimate mixture by powerful paddles. In the Louisville factory there are thirty vertical 150-gal. mixers and four 450-gal. horizontal "Jumbo" ceiling mixers, all of which are driven from a line shaft by the same 20-hp motor which operates the grinding mills last mentioned. These mixers are arranged with friction clutches so that any one or more tanks can be operated without interfering with the others.

A putty mill driven by a 20-hp separate motor is shown in Fig. 5. The chaser used is in general similar to that illustrated in the paint-grinding processes shown in Fig. 1. Two huge cast-iron wheels are used, and the machine complete weighs about four tons. Plows attached to the vertical rotating shaft

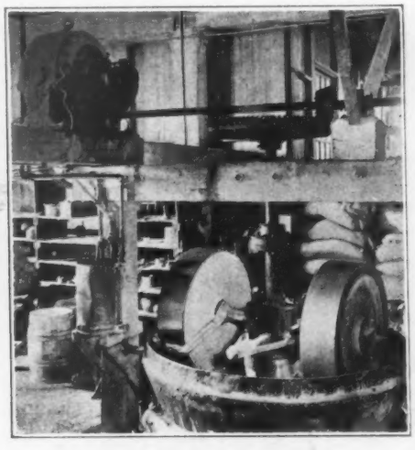


Fig. 5—Motor Geared to Putty Mill.

undercut the contents of the pan and throw them continuously under the rollers, effecting a thorough mixing action on the dry materials and oils out of which the putty is made.

The factory described has an output of about 3500 gal, of mixed paints per week and also produces about 12 tons of leads,

zincs and paste goods. Electricity is used for lighting throughout the plant, and the 220-volt tungsten lamps which have been employed have been reported to give very satisfactory life and service. A 3-hp motor is also used to drive two printing presses in the label department. The paint-maker's heaviest season is during the spring months, and the plant described consumes energy at a relatively high load-factor during its ten-hour working day. An average month's bill recently showed a consumption of about 20,000 kw-hours for the motor and lighting loads above described. Mr. Roscoe Woltz is the motor expert for the Louisville Lighting Company and had charge of the conversion of this equipment to central-station drive. The photographs reproduced herewith were obtained for illustrations in *Chained Lightning*, the monthly publication issued by the Louisville company.

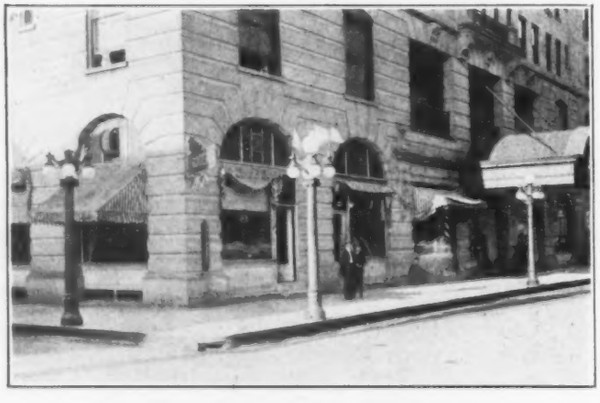
ELECTRIC SIGNS IN BALTIMORE.

The Consolidated Gas, Electric Light & Power Company of Baltimore is conducting an aggressive advertising campaign for "Brighter Baltimore." From illuminated signs on billboards, cleverly writen advertising copy in all of the leading dailies of the Monumental City and circular letters to the leading merchants the central station is endeavoring to install electric signs throughout the business section. And it is succeeding. During recent weeks many public-spirited merchants are using energy for this purpose. Among the new signs that have been erected in Baltimore are the Teddy Bear sign on the New Theater and the new Victoria sign on the Victoria Theater. The new Bay Line pier will have a waving flag, as well as the monogram of the company depicted in electric signs that will be seen down the harbor. The Chesapeake & Potomac Telegraph Company has purchased from the Federal Sign Company a sign for the roof of its big office building on Light Street. This sign will be 72 ft. in length and about 12 ft. in height and will be one of the largest so far erected.

Wiring and Illumination

CURB LIGHTING IN FT. WAYNE.

Several months ago the property owners and business men in the central district of Ft. Wayne, Ind., decided to introduce a system of ornamental curb lighting. The accompanying illustration shows the attractive lamp standards which have been installed, the photograph showing the Anthony Hotel in the background. These posts are known as the "Fort Wayne Ionic standards." Each supports five tungsten lamps. The property owners agreed to purchase and install the lamps and posts, while the city, which operates a municipal plant, arranged to supply the necessary electricity. The lamps are connected to two circuits, one supplying the larger units on the tops of the posts, which are lighted all night, and the other the four lower lamps below the brackets, which, with the topmost lamp, operate until midnight. The lamp surmounting the post is rated at 100 watts, and each of the others at 60 watts. The globe for the former is 14 in. in diameter and those for the latter are 10 in. The shafts and capitals of these posts, which were designed and manufactured by the Western Gas Construction Company, are of pure Ionic design.



Curb Lighting in Ft. Wayne, Ind.

THE ENGINEERING OF INDIRECT ILLUMINATION.

By Jas. R. Cravath.

Although many articles have appeared giving details of the methods used for calculating direct illumination and planning such installations, very little has been written on the methods of planning installations of indirect lighting. A description of some of the methods worked out by the writer for the handling of this class of work in numerous indirect lighting installations during the past three years may be of interest in view of the increasing use of semi-indirect and indirect methods of lighting.

Of course, the first thing to be determined is whether the room in question is suited to indirect lighting. The first requisite is a light-colored ceiling. Pure white is the best reflector, and the nearer white the color of a ceiling the more efficient will be the reflection from it. It is usually desired to introduce some tint which may be more pleasing than dead white for decorative reasons. The addition of any tint lowers the efficiency, but a cream tint, for example, lowers the efficiency less than does green, which is a very inefficient reflector; in fact, considerable cream tint can be introduced without seriously affecting the efficiency of reflection. Brown and red are, of course, very inefficient. The color which is likely to be most deceptive is gray. Even the lighter tints of gray are poor reflectors, as they contain much black, gray being really a mixture of black and white.

Next after the color of the ceiling comes the question of its surface and contour. This immediately brings up the question of the type of indirect lighting which is to be installed.

The present article will deal only with indirect lighting from fixtures hung in the centers of the areas to be lighted and well away from the walls. Indirect lighting from coves will not be considered here, as it usually requires special shapes of ceilings in order to get reasonably good efficiency. Indirect lighting of the type which will be considered—that is, from inverted reflectors on pendent fixtures—can be carried out with ceiling outlets located in the centers of small rooms and in the centers of bays of large rooms, the outlets in general being located as for direct lighting. Such indirect lighting does not require any special architectural treatment of the room. In general the best conditions for it are the ordinary flat ceilings with a smooth surface. Corrugations in the ceiling tend to lower the efficiency for reasons which will be explained later, and in some cases arches and beams will lower the efficiency. Of course, by using enough electrical energy indirect lighting can be accomplished with ceilings of unfavorable shapes, surface or

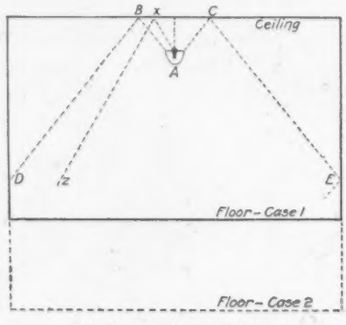


Fig. 1—Section of Room.

color, but these factors must be fully recognized and allowance made for them when planning the installation.

Fig. 1 shows a typical case of indirect lighting from a fixture hung in the center of a small room with a flat ceiling. It represents a cross-section of such a room. An inverted reflector with a lamp in it, located at *A*, throws a cone of light to the ceiling. Most of the flux of light strikes the ceiling between the points *B* and *C*. From *B* and *C* to the walls there should be a gradual tapering off of the illumination on the ceiling if a pleasant effect is to be produced. The reason for confining most of the flux of light to the center of the ceiling is to secure the best efficiency possible. For example, the ray *AX* in Fig. 1, if reflected from the ceiling at the same angle as its incidence, will take the path *XZ* and reach the working plane in the room directly from the ceiling with only one reflection. On the other hand, rays given off from the lamp and reflector at angles more oblique than the angle of the ray *AB* would strike the ceiling outside of the area between *B* and *C*, and if regularly reflected—that is, reflected at the same angle as that of incidence—would strike the wall and would necessarily undergo another reflection before reaching the working plane.

In these two cases just noted the assumption was made that the ceiling gives "regular" reflection like a mirror, with the angle of incidence equal to the angle of reflection. This assumption is necessarily made for the purpose of arriving approximately at the correct principles to follow in the design of indirect illumination. As a matter of fact, however, it is known that every calcimined or painted ceiling is not a regular reflector, but an irregular or diffuse reflector. Such ceilings are slightly rough. Each minute portion of the ceiling must be considered as a reflector by itself, and the minute portions are at an infinite number of different angles with reference to the general plane of the ceiling.

The effect of diffuse reflection is shown in Fig. 2, where *AB* represents the plane of the ceiling and *SC* a beam of light striking the ceiling. If the ceiling were a regular or plane reflector the beam would be reflected from the ceiling at the same angle as the angle of incidence and would take the path *CM*. As a matter of fact it is diffused in various directions and takes various paths as indicated by the dotted lines. The subject of diffuse reflection was recently investigated by Mr. F. H. Gilpin and reported in the Illuminating Engineering Society *Transactions* for 1910. Fig. 2 is taken from an actual test by Mr. Gilpin on a certain sample of paper; it shows the relative amount of diffuse reflection in various directions in one of his tests. From this it is seen that, although the ceiling is far from being a regular reflector, nevertheless the intensity of reflection at the angle equal to the angle of incidence is greater than at any other angle. Hence in the theory of indirect illumination design it is proper to consider primarily the regular reflection from the ceiling.

It is common for those seeing indirect lighting fixtures for the first time to express wonder that there is no shadow of the fixture itself immediately under the fixture. If the ceiling were a perfectly plain mirror it is evident that there would be such a shadow. However, from an inspection of Fig. 2 it is seen that it is impossible for such a shadow to exist, because of the diffuse reflection of the light from all parts of the ceiling surrounding the fixture outlet. As a matter of fact the lightest place in the room is the point directly underneath the fixture, except in rare cases, where a very large bowl type of fixture is placed too close to the ceiling.

The influence which the shape of the ceiling may have on efficiency can easily be seen from Fig. 3, which represents the cross-section of a room having a ceiling with a large number of beams. Even though the beams are light in color they considerably interfere with efficiency. For example, the ray *A* would strike one side of a beam and if regularly reflected would be reflected to the ceiling, undergoing a second loss by reflection before it could be reflected back to the working plane. The ray *B* would be reflected from the side of the beam to the ceiling, thence to the side of another beam and thence to the upper part of one wall, so that it could not reach the working plane until after a fourth reflection. Of course, the fact that the ceiling and wall surfaces are diffuse reflectors modifies the assumption considerably, but by proceeding along the lines which give the highest efficiency on the assumption that the ceiling and walls are regular reflectors one may be sure of obtaining the maximum results.

In the lighting of small rooms, say, from 10 ft. to 20 ft. square, the common practice for the majority of conditions is to locate an outlet at the center of the ceiling. This is good practice both for direct and for indirect lighting. When planning the lighting of larger interiors the space to be lighted should if possible be divided up into squares with an outlet at the center of each square, or rectangle, just as would be the case with direct lighting. When planning direct lighting each lamp is assumed to throw a cone of useful light which will cover a certain area or circle. For example, the room which is shown in cross-section in Fig. 4 has two direct-lighting units. The cone of light from each covers a certain area. If the reflectors are translucent considerable light will be given off outside of the cones indicated. The object of the designer of efficient direct illumination, however, is to confine a considerable portion of the flux of light within a certain cone, and to locate the outlets so that the cones will cover the area to be lighted. In practice in a large interior the cones of light overlap each other and, in fact, considerable overlapping is always desirable on account of the reduction of objectionable shadows.

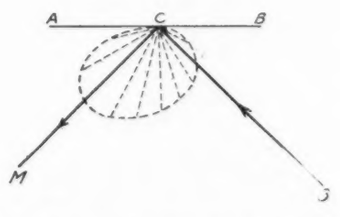


Fig. 2—Diffuse and Regular Reflection.

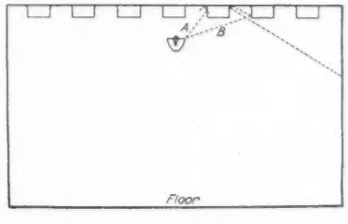


Fig. 3—Loss with Irregular Ceiling.

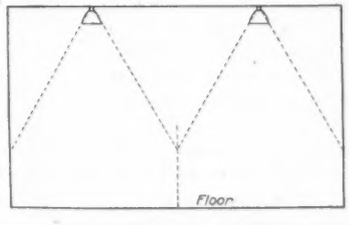


Fig. 4—Cones of Light.

In the planning of indirect-lighting installations one must deal also with the fact that properly designed indirect-lighting units give cones of light just as do direct-lighting units. Thus in Fig. 1 *BCED* represents the lower part of a cone of light obtained by reflection from the cone *ABC*. The diameter of the base of the cone in Fig. 1 can be increased by lowering the fixture *A* or decreased by raising the fixture nearer the ceiling. To be sure, there is no well-defined cone in either the direct or indirect installations referred to, but there are certain limits within which one must work if good results are desired.

Referring again to Fig. 1, the cone of light of which *DE* is the base is just sufficient to cover the working plane with the floor located as in case 1, indicated by the solid line. If the height of the room be so increased that the floor is located as in case 2, Fig. 1, indicated by the dotted lines, and if the fixture be left in the same position relative to the ceiling, it is evident that much more light will be directed to the walls than in case 1. The flux of light striking the wall represents a certain loss, which may be considerably greater than in case 1. Thus it is impossible to light high rooms as efficiently as low rooms by indirect lighting. In case 2, Fig. 1, better results

could be obtained by using a more concentrating reflector, or raising the reflector *A* nearer the ceiling, so as to reduce the diameter of the base of the cone of light that less may strike the wall.

On account of the diffuse reflection from ceilings and walls it is impossible to control the flux of light very accurately with

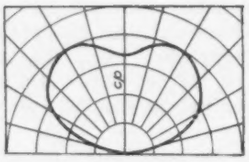


Fig. 5—Relative Distribution of Light from a Distributing-Type Indirect Reflector.

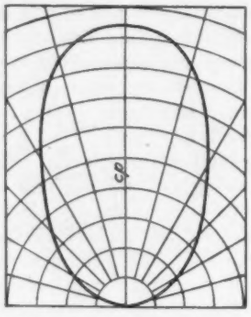


Fig. 6—Relative Distribution of Light from a Concentrating-Type Reflector for Indirect Lighting.

indirect lighting, and in high, narrow rooms the efficiency must necessarily be lower than in low, wide rooms. The same thing is true with direct lighting, but the light can be more nearly controlled when one is dealing with the reflection from reflectors over lamps than when dealing with diffuse reflection from ceilings.

Some early experiments with indirect lighting of this type led the writer to believe that in small, high rooms marked differences in efficiency would be secured by raising and lowering the reflector. Thus in a room 9 ft. x 9 ft. and 11 ft. high it was found by rough tests that more illumination could be obtained at all points in the room by using a concentrating reflector placed close to the ceiling than by using a more diffusing reflector hung down some distance from the ceiling. Subsequently more accurate tests showed conclusively that, while this principle is both theoretically and practically correct, nevertheless the actual difference observed by raising and lowering the reflector within a considerable range is not what was at first supposed; in fact, in many cases the difference is so small that general appearances of the fixtures and the appearance of the light distribution on the ceiling carry more weight than the difference in light distribution on the working plane with any one of several heights of fixture suspension.

In Fig. 5 is given the polar candle-power curve from a type of reflector designed for indirect lighting of this character and classed as of the distributing type. With this reflector the lamp filament is about even with the top of the reflector and considerable light is given off to light the far corners of small rooms, in which it may be hung in the center. In Fig. 6 is given the polar candle-power curve of a reflector for similar uses, classed as of the concentrating type. The distribution of light obtained on the working plane with the reflector shown in Fig. 5, under given conditions, is shown in Fig. 7. This is a curve showing the ft.-candle illumination along a radial line, beginning at a point directly underneath the reflector. The test was made in a very large room with a ceiling 13.5 ft. high and the reflector 36 in. from the ceiling. Reflection from surrounding walls, etc., enters into the curve Fig. 7 to some extent. For the lighting of a large general office with reflectors of this kind at the ceiling height mentioned remarkably uniform illumination can manifestly be obtained by placing lamps at outlets 20 ft. apart.

With types of reflectors the candle-power distribution of which is illustrated in Figs. 5 and 6 the lamp filament is placed vertically within the reflector. It has not been found feasible to design reflectors which will permit spacing of outlets more than 20 ft. apart when very uniform illumination is desired in a large area with ceilings 14 ft. high, although very good results would be obtained with 24-ft. spacing. This is because of the limitations of the cone of light given from a reflector or group of reflectors at a single outlet. For example, the portion of a cone indicated by *DBCE* in Fig. 1 represents what might be called the cone of useful light from a reflector of the type of distribution shown in Fig. 5. The cone for Fig. 6 would have a narrower angle. The area of the base of this cone, as before explained, will be dependent on the distance the reflector is hung from the ceiling and on the ceiling height. In order to serve as a rough guide in determining distances of reflectors from ceiling and probable wall losses in various sizes of rooms it is well to prepare for each type of reflector used a piece of tracing cloth or transparent celluloid having the angle *ACE* marked upon it. A cross-section of the room should be drawn, for example, as in Fig. 1. Then by laying the angle *ACE* marked on tracing cloth over the cross-section of the room the amount of area that can be covered and the suspension height of the fixture can be determined at once. As before stated, however, considerable latitude can be allowed in fixture height. It is, however, manifestly uneconomical to hang a fixture with a distributing type of reflector very low in a high, narrow room.

In the lighting of large interiors with flat ceilings with indirect illumination of this kind, a safe general rule is that outlets can be spaced in the centers of 10-ft. to 24-ft. squares if the ceilings are 10 ft. to 14 ft. With very high ceilings the number of outlets can be considerably reduced. It is simply a case of drawing a cross-section of the room to scale and applying the critical-angle diagram spoken of to determine what the safe procedure may be.

DETERMINING THE NUMBER AND SIZE OF LAMPS.

The following very simple rule is used to determine the number and size of lamps for any given area to be lighted:

Multiply the average ft.-candles desired by the area in square feet, and divide this product by the percentage of efficiency. The result will be the number of lumens which the lamps must provide in order to compensate for all losses and deliver the required average number of ft.-candles. The percentage of efficiency is derived from actual tests on installations of a character similar to those under consideration.

Having determined the total number of lumens necessary by the foregoing rule, use can be made of lamp manufacturers' tables which show the lumens for various lamps operated at various voltages. It is then only necessary to provide enough lamps to give the lumens required. American makers of tungsten lamps are now publishing the lumens given by various sizes of lamps as a part of the regular information on these lamps. The number of lumens given by any lamp may be obtained by multiplying its mean spherical candle-power by 12.57. The mean spherical candle-power of the larger sizes of tungsten lamps, such as are mostly used for indirect lighting, is obtained by multiplying the mean horizontal candle-power

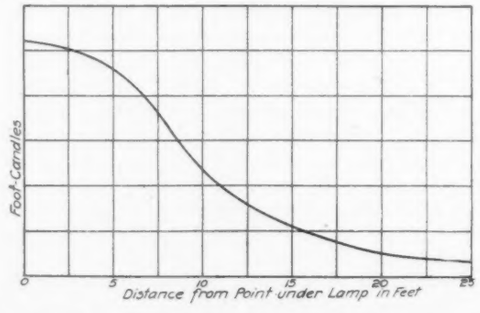


Fig. 7—Illumination from One Lamp (Reflector Shown in Fig. 5).

by 0.78. In the absence of manufacturers' tables this suggestion may be of value for rough work.

On account of the fact that the efficiencies of tungsten lamps of a given wattage rating are being changed from time to time by manufacturers, it is no longer feasible to use tables of watts per square foot, or watts per lumen, based on a constant effi-

ciency of tungsten lamps, since the tables would have to be revised every time the lamp manufacturers change the lamp efficiencies. It is, therefore, more feasible to use one table which is of fairly permanent character, giving the efficiency of utilization of light, or, in other words, the percentage of efficiency from the lamps to the working plane in the room. This efficiency is the figure referred to in the foregoing rule for estimating illumination. Table I gives efficiency figures from

TABLE I.—EFFICIENCY CONSTANTS FOR INDIRECT LIGHTING FROM CENTRALLY LOCATED FIXTURES WITH EFFICIENT MIRRORED REFLECTORS AND CLEAN GLASSWARE.

Room.		Color.		Per Cent Efficiency from Lamp to Working Plane.
Height, Feet.	Dimensions, Feet.	Walls.	Ceiling.	
8.5	12 x 16.5	Lt. Green	Lt. Cream	29.5
9.8	15 x 15.2	Dark Green	Lt. Cream	28.0
9.8	12.7 x 12.7	Lt. Figures	Lt. Cream	37.0
14.5	57.6 x 70	Lt. Cream	Lt. Buff	36.0

tests on indirect lighting under certain conditions, which the writer believes to be thoroughly reliable. In estimating illumination according to these rules a liberal allowance should be made in addition for dirt on reflectors and lamps. What this allowance should be will depend much on the local conditions of the installation. It is usually safe to assume it to be 25 per cent, both for direct and indirect lighting for fairly average conditions.

For the convenience of those who may wish to have the lumens output of various American tungsten lamps before them while reading this article Table II is given, showing the maker's rating in lumens of the various sizes of American-made

TABLE II.—LUMENS GIVEN BY TUNGSTEN LAMPS OF 1910 AMERICAN MANUFACTURE. (SUBJECT TO CHANGE WITH IMPROVED LAMP EFFICIENCIES.)

Rated Watts.	Voltage.	Lumens.
25	Top	187
	Middle	173
	Bottom	160
40	Top	319
	Middle	298
	Bottom	277
60	Top	498
	Middle	464
	Bottom	463
100	Top	830
	Middle	773
	Bottom	722
150	Top	1245
	Middle	1160
	Bottom	1083
250	Top	2168
	Middle	2009
	Bottom	1873

tungsten lamps operated at top, middle and bottom voltage, according to the makers' standards of efficiency adopted in 1910. The manufacturers' policy is to keep the rated watts and the number of hours of life constant and vary the efficiency from time to time as improvements in lamp manufacture make it possible to do so. Consequently Table II is likely to become out of date at any time.

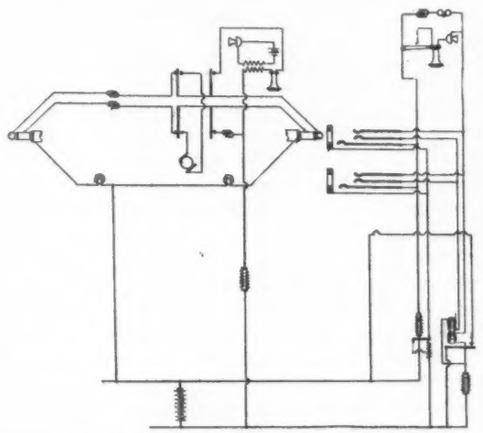
Although the number of tests given in Table I is small, yet it is believed that they are thoroughly accurate for the conditions stated and that with judgment the engineer can use them for a majority of cases which come up in practice after making allowance for conditions differing from those shown in the table.

RECENT TELEPHONE PATENTS.

COMMON-BATTERY SWITCHBOARD.

There have been patented many schemes for common-battery switchboards wherein a differential relay was used to control the line signal. In many of these, however, the two coils of the differential relay were in different parts of the circuit where, no matter how careful the detail design, the leakage factor of practical working will be sufficient to destroy the balance. In the system patented by Messrs. D. L. Temple, of Chicago, and C. L. Goodrum, of Atlantic City, this difficulty is overcome. Furthermore complete supervisory signals are provided without the necessity of relays in the cord circuits.

By referring to the cut it will be noted that one winding of the differential line relay is permanently associated with one side of the line. The actuating circuit may be traced out to the hook switch and thence back through an auxiliary relay to the battery. Closing the circuit at the substation causes the actuation of the line relay and the display of the line lamp. Upon



Temple and Goodrum Telephone System.

the response of the operator the plug tip registers not only with the usual tip contact, but it also engages a fourth or extra contact. By so doing the second winding of the line relay is cut in parallel with the first and thus both are subject to the same current fluctuations and a differential balance is insured at all times.

Inspection of the auxiliary relay will show that when it is actuated a short-circuit is removed from resistance in the sleeve wire of the jack. This is the part of the circuit which includes the supervisory lamp of the cord circuit. Thus if the resistance be high enough the supervisory lamp will not glow when the relay is actuated, but will glow with the resistance short-circuited. This patent is assigned to the Stromberg-Carlson company.

IMPROVED MOUTHPIECE.

Recently several patents have been granted to Mr. L. Steinberger, of Brooklyn, for special designs of mouthpiece. There is now at hand another modification. This improved mouthpiece has the usual contour, but it is made as near a solid piece as practicable. The front face is slightly hollowed out to form a shallow basin. Conical sound passages lead from this basin through to the base of the mouthpiece block. Some of the passages have their taper toward the diaphragm and some have the reverse taper. The idea is to provide a practically unbreakable mouthpiece which will be efficient.

MESSAGE METER.

Mr. G. W. Lorimer, of Piqua, Ohio, has obtained a patent for a message-counting device adapted to the requirements of a special type of automatic-exchange system. Provision is made to prevent a registration before actually initiating a switch or call. The meter is also locked until connection is established. No further connection may then be initiated until a count has been recorded.

Letters to the Editor.

"Synchronizing Reactance."

To the Editor of Electrical World:

Sir:—With reference to the article "Synchronizing Reactance" published in the *Electrical World* of April 20, 1911, I beg to call attention to the fact that the underlying principle of this synchronizing method was described in a German patent, No. 214,057, filed Oct. 27, 1907, and issued to me on Sept. 23, 1909. The function of my "Spannungswandler" of this patent corresponds to that of the "synchronizing reactance" of the above article. Although my patent employs additional means for indicating the proper moment of synchronism, on the basis of a pending American application, filed prior to the German, I am entitled to claims which broadly cover the synchronizing method described in the article.

New York C. A. Lohr.

Regenerative Control.

To the Editor of Electrical World:

Sir:—I wish to call attention to a slight mistake which crept into the last line of my letter as published in your issue of April 27. Unfortunately it makes no sense as it stands. I had written "there is no doubt that regeneration has reached a stage where it is bound to bring about revolutionizing commercial saving." In other words, I wished to convey, without going into a lengthy explanation, that regeneration had reached a point where it can be proved to bring about not only a saving of energy and brake-shoe maintenance, but such a saving as to leave a sufficient net balance in dollars and cents after everything in the way of additional repairs, additional interest on first cost and additional sinking-fund charges has been debited against the savings to revolutionize electric traction completely. As it reads now, "bound to revolutionize commercial saving," it does not even hint at the idea I had in mind. I should be glad to have you correct this last line so as to convey my thought.

Davenport, Ia. J. Gustaf V. Lang.

Characteristics of Various Illuminants.

To the Editor of Electrical World:

Sir:—A statement in the editorial appearing in the *Electrical World* for April 20, which discusses the article "Comparison of the Operating Characteristics of Various Illuminants," by Mr. Isador Ladoff, has led me to check up the total operating costs of some of these units. Mr. Ladoff has, of course, aimed to present data on the cost of energy alone for the different lamps, and it is not my desire to make any criticism of his article. However, I do feel that there is an unfortunate tendency to compare illuminants solely on the basis of energy consumption per unit of light flux generated, and that this tendency is strengthened rather than discouraged by the statement in the editorial that the relative positions of the four classes of illuminants would remain substantially unchanged by the inclusion of incidental charges. I can scarcely agree with this statement. The necessity for a complete analysis of the cost of lighting with the various illuminants cannot be too strongly urged. This point has been emphasized in recent numbers of the *Electrical World* by the letters of Mr. J. S. Codman, Jan. 12, 1911; Mr. Sydney W. Ashe, March 2, 1911, and Mr. R. Hillberg, April 6, 1911, yet its very general neglect seems to warrant a repetition of the fundamental considerations in a cost comparison.

In determining the total operating cost of any system of commercial or industrial lighting three items must be considered:

(a) Fixed charges, which include interest on the total investment, depreciation on permanent parts, and other expenses which are independent of the number of hours the lamps are used. Frequently this item forms the greater part of the total operating expense, yet it is almost invariably omitted from cost tables.

(b) Maintenance charges, which include renewal of parts, repairs, labor and all costs, except the cost of energy, which depend upon the hours of burning.

(c) The cost of energy, which depends upon the hours of burning and the rate charged for energy.

A charge of 6 per cent on the total investment is the lowest rate which will cover the items of interest, taxes and insurance. The allowance which should be made for depreciation is more difficult to determine, for obsolescence rather than the actual wearing out of parts usually determines the life of a lighting unit. The model lighting systems of six or seven years ago can profitably be replaced by the more efficient lamps of to-day, and there is every reason to believe that the rapid progress in the development of lighting units will continue. The careful investor will therefore consider a depreciation rate of not less than 12.5 per cent per annum when computing the total operating expense for a proposed installation. In the case of lamps which require renewal of parts at frequent intervals, the cleaning of globes and reflectors is usually included in the cost of trimming. Although mercury-vapor and incandescent electric lamps do not require frequent trimming, they should be cleaned at regular intervals. Thus this cost becomes a separate and fixed charge.

In order to compare the cost of illumination with two different units, it is further necessary that this comparison be based upon equal illumination from the two units under average service conditions. It is important, therefore, that in the case of units which are in practice used with a diffusing globe the values of candle-power obtained with this equipment rather than with clear globes should be considered. The comparative steadiness of the two light sources must also be taken into account. A discussion of this point will be found in the letter by Mr. Charles L. Tremaine in the Feb. 23, 1911, issue of the *Electrical World*. As was pointed out in the letter by Mr. Ashe, the ratio which the average candle-power of a lamp bears to the initial varies greatly with different lighting units. The illuminants which fall in the third and fourth groups according to the classification given in the editorial are particularly at a disadvantage in this respect.

	10-amp Inclined Flame-Arc Lamp.		1000-watt Cluster Tungsten-Filament Lamps.	
Terminal volts		55		110
Terminal watts		550		940
Cost of reflector-socket		.....		$7.00
Cost of lamp		$60.00	4x2.75	11.00
Total investment		60.00		18.00
Investment in permanent parts		60.00		7.00
Annual fixed charges:				
Interest at 6 per cent		$3.60		$1.08
Depreciation at 12.5 per cent		7.50		0.87
Cleaning		.....	12x0.05	0.60
Total		$11.10		$2.55
Maintenance per 1000 hours:				
Globes	1x1.50	$1.50		.....
Economizers	2x0.20	0.40		.....
Electrodes	60x0.15	9.00		.....
Trimming, inspection and cleaning	60x0.075	4.50		.....
Repairs		1.00		.....
Lamp renewals		.....	$\frac{1}{1.7}$x11.00	$6.47
Total		$16.40		$6.47
Energy cost per 1000 hours at 1 cent per kw-hour		$5.50		$9.40
Total annual operating cost, 4000 hours operation, energy at 2 cents per kw-hour:				
Fixed charges		$11.10		$2.55
Maintenance	4x16.40	66.60	4x6.47	25.88
Energy	2x4x 5.50	44.00	2x4x9.40	75.20
Total		$121.70		$103.63

To illustrate the importance of these considerations I have analyzed the total operating cost of illumination with a 10-amp inclined flame-arc lamp and with a cluster of four 250-watt tungsten-filament lamps under conditions which are commonly met with in industrial lighting. The life of the tungsten-fila-

ment lamps has been taken at 1700 hours, corresponding to operation at low efficiency, which is the most economical at costs of energy below 4 cents per kw-hour. The rated life of seventeen hours has been assumed for the electrodes of the flaming arc.

From the table in Mr. Ladoff's article it appears that a tungsten filament lamp is more than five times as expensive as an inclined flame-arc lamp when only the cost of energy for total light flux generated is considered; yet in actual practice it is found that a higher illumination can be obtained from a 1000-watt cluster than from the 10-amp arc with the standard globe equipment. Even if the illuminations be regarded as equal it is seen that the total operating cost under conditions which are typical of industrial lighting is considerably in favor of the 1000-watt cluster.

On the other hand, if the same units were used for 1000 hours per year on a commercial circuit with energy at 10 cents per kw-hour there would be a saving of more than 20 per cent in favor of the flame-arc lamp. This emphasizes the necessity for making a complete cost analysis.

H. H. MAGDSICK.

Cleveland, Ohio.

Digest of Current Electrical Literature

ABSTRACTS OF THE IMPORTANT ARTICLES APPEARING IN THE ELECTRICAL PERIODICAL PRESS OF THE WORLD

Generators, Motors and Transformers.

Armature Reaction of Three-Phase Generators.—W. ROGOWSKI.—The first step of Blondel's theory of armature reaction is to resolve the armature current into a watt component and a wattless component (with respect to the emf induced by the field). It is then possible to proceed in either of the following two ways: (a) The real field in the loaded machine is resolved into three imaginary fields; first, the exciter field, due to the mmf of the excitation; second, the counter field, due to the ampere-turns of the wattless current, and, third, the cross mmf, due to the ampere-turns of the watt current. The emfs induced by each of the three fields are calculated and combined to find the resultant emf E, which was to be determined. (b) In the second method the field of the loaded machine is resolved into only two imaginary fields, namely, the main field (equal to the sum of the exciter field and counter field in case a) and the cross-field. The emfs induced by the main field and cross-field may be E_1 and E_2 respectively. Now the following two problems are solved. First, how many ampere-turns must be given to the excitation at no load in order to get the emf E_1. If $Z_1 - X$ ampere-turns are required when Z_1 is the number of ampere-turns of the excitation of the loaded machine, then X is called the number of "counter-turns" (Gegenwindungen) of the machine. Secondly, how many ampere-turns are required on the cores in order to produce E_2 at no load? If Y ampere-turns are required, Y is called the number of "cross-turns" (Querwindungen) of the machine. Reversely, if X and Y are known, the two emfs E_1 and E_2 can be found directly from the no-load characteristic curve and by combining them the desired emf E of the loaded machine can be found. The author shows that there is something arbitrary in the conception of the counter-turns and cross-turns. Further, the second method (b) seems to be somewhat roundabout. However, it is justified by the fact that the counter-turns and cross-turns can be easily calculated by the wattless and watt ampere-turns of the machine, that they depend very little on the iron saturation, and that by a glance it is possible to judge from the no-load characteristic curve the magnitude of the emfs induced by the armature and the magnet field. The author shows that it is possible to avoid whatever is arbitrary in the definition of the counter-turns and cross-turns and describes a simple method for determining them.—*Elek. Zeit.*, March 23.

Single-Phase Commutator Motors.—J. REYVAL.—A review of a recent paper of Niethammer on the properties of a single-phase commutator motor, with two sets of brushes perpendicular to each other. It has the properties of the series or repulsion motor on starting and at the same time the property of an induction motor of practically constant speed in normal operation.—*La Lumière Elec.*, April 8.

Lamps and Lighting.

Fluctuation of Temperature of Alternating-Current Lamps.—O. M. CORBINO.—The author shows how the Braun cathode ray tube can be utilized to determine the resistance fluctuations of a metallic-filament lamp when operated by alternating current. He experimented with osram lamps of 16 cp and 32 cp at 105 volts and 42 cycles. He finds that the temperature of the 32-cp filament fluctuates about 10 deg. C. above and below the mean temperature, while the corresponding amplitude of the fluctuation of the 16-cp lamps is about 15 deg. C. He finally shows how to determine from his experiments the ratio of thermal capacity and the temperature-resistance coefficient of the filament at the temperature of normal operation. In order to increase the temperature of the filament to such a degree that its resistance varies by 1/1000, one-tenth of a gram calorie is required for each gram of its mass.—*Phys. Zeit.*, April 15.

Metallic-Filament Lamps.—A note on a recent British patent (24,549, April 13) of F. Skaupy, of Berlin, Germany. In order to reduce disintegration of the filament and consequent blackening of the bulb, the stem of the filament carrier is made hollow and contains a small quantity of halogen compound, the gas from which tends to prevent the disintegration. The hollow stem is in communication with an open sphere or bulb at the free end of the stem, and any deposit from the halogen compound is retained in this.—Lond. *Elec. Eng'ing*, April 20.

Metallic-Filament Lamps.—A note on a recent British patent (23,535, April 13) of G. F. Attwood, of Newark, N. J. Metallic filaments are particularly susceptible to breakage adjacent to the supports because the rigid connections render them less flexible at these points. According to this invention, the filament is fused to the extremity of the support as usual, but its movement at this point is limited by coiling the filament a few turns round the support. The use of two or more filaments in parallel for low-voltage lamps similarly coiled round the supports at their extremities is also covered by this patent.—Lond. *Elec. Eng'ing*, April 20.

Metallic-Filament Lamp.—A note on a recent British patent (15,621, April 6, 1911) of F. Skaupy. It describes the insertion into metallic-filament lamp bulbs of chemical compounds, which, when heated by the normal working of the lamp, will give off halogen vapors. If the pressure of the gas is so small as to be hardly measurable, its presence is said to diminish the disintegration of the filament and consequently blackening of the bulb.—*Lond. Elec. Eng'ing*, April 13.

Generation, Transmission and Distribution.

Steam Plant.—F. L. RICHTER.—The conclusion of his illustrated article on steam plant exhibits at the World's Fair in Brussels in 1910. In the present instalment the author deals with steam turbines and condensers.—*Elek. Zeit.*, April 6.

Traction.

Electric Traction on Main Lines in Europe.—J. B. SPARKS.—An abstract of a paper giving a review of the present status of heavy electric traction in Europe. In Germany the Prussian authorities have adopted the single-phase system at 10,000 volts, 15 cycles, and a large sum of money has been granted for the equipment of some 95 miles of double track between Magdeburg, Leipsic and Halle. A 16-mile section of this line has already been equipped and several different types of locomotives are undergoing trials. Some 180 miles of line in Silesia will

also shortly be equipped on the same system. The State railway authorities of Bavaria and Baden respectively have also adopted the single-phase system of 10,000 volts, 15 cycles, and short main sections between Salzburg and Freilassing, in Bavaria, and between Basle and Zell, in Baden, are already being equipped. Plans have also been prepared by both states for the conversion of a large number of other lines. The Austrian State Railways will shortly have 29 miles of line near Trieste working on the single-phase system at 10,000 volts, 15 cycles, and plans have been prepared for a large number of lines south of the Danube. The Austrian South Railway Company intends to introduce three-phase traction on certain of its lines, and the same system may be employed for some of the State railways. A new main line, to be worked on the single-phase system at 10,000 volts, 15 cycles, is being constructed in the northeast of Austria to provide an additional connection between the railway systems of Bavaria and Austria. The Hungarian State railways will shortly have an important suburban system at Budapest, working electrically at 10,000 volts, 15 cycles, single-phase, and a portion of the main line between Prague and Vienna is also to be equipped shortly. Plans are also ready for a 56-mile section of the important line between Fiume and Budapest. The Swiss Federal Railways have decided to adopt the single-phase system at 15,000 volts, 15 cycles, and the St. Gothard Railway will probably be the first to be equipped. A short section of the Loetschberg Tunnel line, now under construction, is already working electrically on this new system. The equipment of the Simplon line, which is worked at 3000 volts, 16 cycles, three-phase, is to be extended at the Italian end of the line. The conversion of the 12-mile Giovi Tunnel line to 3000 volts, 16 cycles, is practically completed, as is also the Mont Cenis Tunnel line. A number of other main sections are shortly to be converted, but not necessarily on the three-phase system. The French State railway authorities are considering the introduction of electric traction on lines near Paris, and will assist in the conversion of the belt line just inside the fortifications. The Chemins de Fer du Midi have adopted single-phase at 12,000 volts, 16 cycles, and are already equipping a 70-mile main line section between Pau and Montrejeau, while it is probable that the whole 250 miles of line between Toulouse and Bayonne will be working electrically in a few years. The P. L. M. Company is making experiments on an electrically equipped track at Grasse, and has in view the conversion of the main line section between Cannes and Ventimiglia. The Swedish State Railway authorities have also adopted the single-phase system at 15,000 volts, 15 cycles, and an 80-mile line in the north is being equipped. Plans have also been prepared for the conversion of the whole system of lines south of Stockholm, and the necessary water-power has been secured. In Norway a 30-mile line is being converted to single-phase, working at 10,000 volts, 16 cycles.—Lond. *Electrician*, April 21.

Installations, Systems and Appliances.

Effect of Tariff on the Financial Results of Central Stations.—Norberg Schultz.—On the basis of statistical data collected from various European central stations the author investigates the effect which a change of tariff has on the financial results. Figs. 1 and 2 show the results obtained by the central station of Christiania in Norway, where up to 1898 a meter tariff was used, while later on flat rates were introduced, the mean receipts per kw-hour sold being gradually reduced from 15 cents downward. In Fig. 1 the abscissas give the average receipts in cents per kw-hour sold, while the ordinates give the average hours during which the kilowatts installed were used. It is seen that the hours of use remained practically constant as long as the average price of the kw-hour was above 7.5 cents. When the price decreased below this value the hours of use increased rapidly. In Fig. 2 the abscissas represent again the price of the kw-hour in cents received by the central station, while the ordinates represent the yearly receipts in dollars per kw-hour installed. With decreasing prices of the kw-hour the yearly receipts per kilowatt decrease, but on the basis of the experience of the last years in Christiania it seems that they tend to reach a minimum limit of $25 per kilowatt installed. Similar results are obtained from the statistical data of several other stations all of which use essentially flat-rate tariffs, and in all of them the limit value of the yearly receipts per kilowatt installed seems to be $25. While the conditions in general are similar in stations which use meter tariffs, the minimum limit of the yearly receipts per kw-hour seems to be in this case less than before, the figures for three stations being $18.75, $12.50 and $15 respectively. All the statistical data seem to

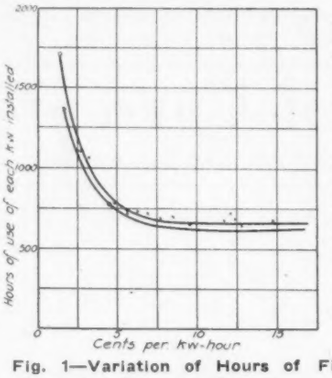


Fig. 1—Variation of Hours of Use with Rate for Energy.

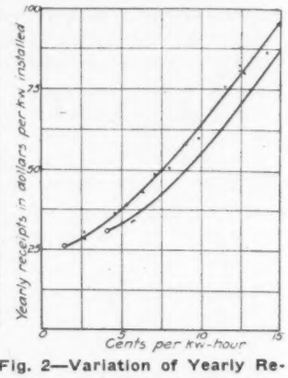


Fig. 2—Variation of Yearly Receipts with Rate for Energy.

prove that the flat tariffs give a higher yearly receipt per kilowatt installed than meter tariffs. The author finally investigates the effect of a change of tariff on the maximum load factor and the diversity factor and gives some general results, although it would seem that in this case there is a much greater difference between different stations. The article is illustrated by numerous diagrams.—*Elek. Zeit.*, March 23 and 30.

Electricity Supply in Country Districts.—W. B. Woodhouse.—A paper read before the Yorkshire Section of the (British) Institution of Electrical Engineers, in which the author first reviews the effect of legislation on the development of electrical industries in Great Britain. The author next refers briefly to the various conditions which govern the cost of electricity. In a typical case the total costs are divided in the following proportion: Capital charges, 50 per cent; coal, 25 per cent; wages, etc., 15 per cent; management, 10 per cent. As the capital expenditure on small undertakings is about equally divided between generating machinery and mains, it is obvious that if a generating station can be avoided, as by taking a bulk supply, the expenditure and the risk are immediately halved. With respect to the distribution of energy the author considers only country districts. In a rural or agricultural district the needs for electricity may be divided under three main heads: Street lighting, cottage and house lighting, motor service supply to farmhouses. In such districts as these electricity supply can only be given at a cheap rate by the use of overhead mains. Underground mains would cost 75 per cent more; or, to regard the matter in another way, energy could be supplied for private lighting at 2 cents per kw-hour less if overhead wires are used. The lighting of country roads by electricity has many advantages over gas lighting. Freedom from disturbance or flickering during wind, rain or frost, better distribution of light between lamps and, therefore, more satisfactory illumination and lessened cost are among them. The use of electricity on farms is steadily increasing. Apart from the saving in cost the greatest advantage for the farmer is the fact that energy is available whenever needed, and when threshing is to be done there is no delay such as frequently happens when a portable engine is required. Electric energy may be obtained from an overhead line at any convenient point; the electric motor may be mounted on a farm wagon and set to drive a threshing machine, a turnip or hay chopper, a pump, or be used for any purpose for which motor service is required on a farm. Moreover, the farmhouse and buildings may be well and cheaply lighted. The small first cost of equipment, the general simplicity and ease of opera-

tion, and the small cost of upkeep are all important advantages, while the use of electric light in barns and buildings reduces fire risk to the lowest level. In a number of cases the electric company's supply has been used for cottage lighting, an inclusive charge per week being made for the supply of energy and lamps, there being no restriction on the hours of lighting. In one such case a group of fourteen cottages are supplied with energy, each cottage being lighted by two 60-watt lamps and two 120-watt lamps. The annual consumption of energy per cottage is 160 kw-hours. The consumption is large on account of the use of carbon lamps. The same illumination from metallic-filament lamps would reduce the consumption to 54 kw-hours per annum, or $4.32 per annum at 8 cents per kw-hour. In another case a group of twelve cottages are lighted each by three 16-cp tantalum lamps at an annual cost of $3.77. Six other cottages each lighted with four 60-watt lamps use an average of 78 kw-hours per annum, costing 12 cents a week at a price of 8 cents per kw-hour.—Lond. *Electrician,* April 14.

Electric Equipment of Barracks.—An illustrated description of the electrical equipment of Victoria Barracks, Windsor. The arrangement is in two halves. Energy is obtained from public mains which supply on the direct-current, three-wire system, the pressure being 220 volts across the outers. After passing through the usual cut-outs, the mains are led into a three-way link box, whence the two lighting circuits are tapped off from one outer and the neutral, while a motor circuit for the elevator is taken from the two outers. This link box makes it possible to change half the building from one side of the system to the other, if necessary. As regards the system of wiring employed, solid drawn-steel screwed tube is used throughout.—Lond. *Electrician,* April 14.

Wires, Wiring and Conduits.

Insulation Resistance in Networks.—F. LEPRINCE-RINGUET.—The conclusion of his mathematical paper on the permanent control of the insulation resistance of an alternating-current network by means of simple voltage measurements. Tests of this kind made in existing installations, especially in the mines of Lens, have shown that the simple voltage measurements are sufficient to determine the danger which may exist to the attendants. The author prefers such voltage measurements to regulations concerning the amount of permissible stray current. As to the question whether the neutral point should be earthed or insulated he concludes that its insulation is preferable as it presents less danger for the security of the workmen. But it is necessary to control every day the condition of the network and its insulation resistance by simple voltage measurements.—*La Lumière Elec.,* April 8.

Electrophysics and Magnetism.

Condensation Nuclei.—G. OWEN and H. PEALING.—An investigation of condensation nuclei produced by the action of light on iodine vapor. Camphor, naphthalene, benzoic acid and iodine do not sublime in the form of particles sufficiently large to act as condensation nuclei for water vapor. When moist air (or oxygen) containing iodine vapor is illuminated nuclei are produced possessing the following properties: The nuclei are very unstable, disappearing in a few seconds in the dark. They do not carry an electric charge. They are not obtained except in the presence of oxygen and water-vapor. They grow under the action of the light, but, generally, do not attain a size greater than that requiring a pressure-fall of 18.5 cm in order to catch them. The light required for their production need not be very intense nor of a high degree of refrangibility. No nuclei are produced after the iodine has been in the apparatus for some days. The cessation of the action is probably due to a state of chemical equilibrium having been attained. The equilibrium is destroyed by rinsing the glass walls of the apparatus with water. Glass-wool possesses the peculiar property of facilitating the formation of the nuclei, the number produced when iodine-laden air is admitted into the apparatus through a plug of glass-wool being much greater than the number obtained on placing iodine directly in the cloud-chamber. This property becomes less and less marked as the wool gets more and more saturated with the iodine. The action of the glass-wool is regarded either as being of a catalytic nature or as evidence of the wool being an unexpected source of contamination for the iodine vapor during its passage through it. —*Phil. Mag.,* April.

Elementary Quantity of Electricity.—Two papers with respect to the experimental investigations of Ehrenhaft, who from experiments with ultramicroscopic particles concluded that they often carry charges much less than the so-called elementary quantity of electricity. A. Joffe points out another source of error in these experiments, while Ehrenhaft replies to the criticisms of Regener, Millikan, and Fletcher and maintains his original position.—*Phys. Zeit.,* April 1.

Gamma Rays.—W. WILSON.—A description of an experiment which was made to determine if the absorption coefficient of iron for gamma rays varies with the temperature. A negative result was obtained.—*Phil. Mag.,* April.

Electrons.—J. W. NICHOLSON.—A theoretical paper on the damping of the vibrations of a dielectric sphere (which is his proposed model of an electron) and the radiation from a vibrating electron.—*Phil. Mag.,* April.

Units, Measurements and Instruments.

Electricity Meters.—J. T. IRWIN.—A further discussion of the recent paper of Ratcliff and Moore. The author deals especially with the effect of wave form on the reading of an induction meter. If both the emf and the current have not a sinusoidal wave form, he shows that the total power is the sum of the powers due to the fundamental third, fifth, seventh .... waves, each considered separately, and if the reading of a meter is made independent of frequency it will also be independent of wave form as long as there is no appreciable change in the permeance of the magnetic circuits. Further if the meter reads correctly at one particular frequency and if one of the curves is a sine wave of this frequency, it does not matter how distorted the other is, the meter will still register correctly. That is to say, if the pressure wave form of an alternating-current system is kept a sine wave, then an induction type meter can be used to register the energy on very distorted waves of current such as arc-lamp circuits, rectifiers, etc., but this is by no means true where the voltage differs from a sine wave. It would be equally true that for a sine wave current it would not matter how much the voltage was distorted. In practice the meters always read slow, and the higher the value of the harmonic in the resultant wave the slower the meters read. This is due to the fact that they do not register correctly the power given by the higher harmonics. The curve in Fig. 3 was obtained by the author for an induction meter, tested on a varying frequency at unity power-factor. It shows that a meter which was correct at its normal frequency of 50 cycles per second was 15 per cent slow at 150 cycles and 23 per cent slow at 250 cycles. The author concludes that each type of meter should be tested at frequencies much higher than those at which it is to be used and rejected if not up to a definite standard. The standard need not be a very rigid one.—Lond. *Electrician,* April 14.

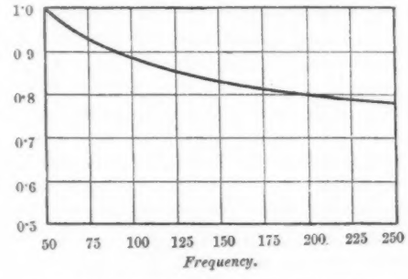


Fig. 3—Effect of Varying Frequency on Induction Meter.

Magnetic Testing of Sheet Iron.—J. EPSTEIN.—A long paper illustrated by diagrams in which the author shows how his well

known apparatus for iron testing can also be used for determining direct-current magnetization. Directions are given of details of the tests. For the measurement of the losses improvements of the original arrangement are described. By subdividing the primary coils into parallel groups stray fluxes are avoided. By simply turning a switch, the same arrangement of the apparatus may be used either for determining the losses or for determining direct-current magnetization.—*Elek. Zeit.*, April 6 and 13.

Electric Contacts.—G. Lippmann.—An abstract of a French Academy paper in which the author points out that if two wires are in contact current will pass through the contact point only when the contact point is maintained under a certain pressure. Such a pressure is not necessary if the contact is made between a metal and an electrolyte. Good results without pressure are obtained, for instance, if one of the electrodes is a strip of paper impregnated with a calcium chloride solution and placed on glass while the other electrode is a simple piece of gold foil. Likewise there is an effective contact without pressure between two amalgamated silver wires while the contact between platinum and mercury is not necessarily effective.—*La Lumière Elec.*, April 8.

Meters.—An official communication of the Reichsanstalt by which three new types of meters of the Aron Company are admitted for calibration. They are a direct-current motor meter, a single-phase induction meter and a three-phase induction meter. Their construction and operation are described in detail.—*Elek. Zeit.*, Apr. 6.

Meters.—An official communication of the Reichsanstalt by which induction meters for balanced three-phase systems of the Siemens-Schuckert Company are admitted for calibration. They are simply modifications of this company's single-phase induction meters.—*Elek. Zeit.*, March 30.

Telegraphy, Telephony and Signals.

Long-Distance and Wireless Telephony.—A note on a recent British patent (7656, April 13) of C. E. Egner and J. G. Holmstrom, of Stockholm, Sweden. A telephone transmitter for dealing with heavy currents has a vessel containing a cooling liquid attached to it so that the bottom of the vessel is in contact with the chamber containing the granules. The heated liquid rises and thus creates a circulation of the liquid. Another method of cooling the transmitter consists of filling the vessel with paraffin wax or other solid body, which is melted by the heat produced.—Lond. *Elec. Eng'ing*, April 20.

Wireless Telegraphy.—K. Fischer.—The author shows that probably there is a relation between meteorological conditions and the maximum distance to which wireless messages may be transmitted. The author recommends quantitative measurements especially with reference to the proposed connection of Germany with its West African colonies by wireless telegraphy.—*Elek. Zeit.*, April 6.

Carbon Granules for Telephone Transmitters.—A. Brookes.—The author points out that the secret of the successful transmission of speech telephonically lies largely in the variation in resistance caused by the carbon granules when the transmitter is spoken into. Hence it is of extreme importance that these particles of carbon shall be of the highest standard of efficiency. One of the troubles with them is what is known as packing. The best way to eliminate packing now recognized in the modern manufacture of transmitters is to insure absolute uniformity in the size of the granules, the use of sharp-cornered granules in preference to spherical, a correct design of the carbon cell and the entire absence of moisture in the cell. The process of manufacturing carbon granules is briefly described.—Lond. *Electrician*, March 31.

Miscellaneous.

Lightning Flash.—R. Rinkel and L. Weber.—An illustrated description of a very heavy lightning flash by which a high tree was badly damaged. The authors conclude that the mechanical forces which must have been acting are so great that they can be explained only by assuming a direct disruption of the tree due to electrostatic charges.—*Elek. Zeit.*, April 6.

Book Review.

Das Elektrische Bogenlicht. By Ewald Rasch. Braunschweig: Friedrich Vieweg & Son. 176 pages, 52 illus. Price, 7 marks.

A brief engineering textbook on the electrical properties of the carbon arc lamp. The mechanism of the arc lamp is left almost untouched. The circuits and generators of current for arc lamps are not discussed. The laws of the production and distribution of light from the arc under different conditions are developed at some length and are discussed in detail. There are eight chapters in the book. No. 1 gives an introduction to the phenomena of the voltaic arc. No. 2 discusses the alternating-current arc, the direct-current arc, the inclosed arc and the open arc. No. 3 treats of the principal electrode substances and their physical properties. No. 4 discusses the theory of electrical discharges in gases at ordinary pressures. No. 5 relates to spark discharges. No. 6 discusses the relations of current and voltage to the dimensions of the carbon arc. No. 7 takes up the distribution of radiant energy in space from the arc. No. 8 treats of practical luminous results obtained with arc lamps. The book is clearly written and illustrated with numerous diagrams. It will be of interest to the technical student of electric lighting.

New Apparatus and Appliances

SINGLE-PHASE CURRENT IN ELECTRIC RAILWAY SERVICE.

By F. H. Dimock.

Single-phase operation of electric railways is especially adapted to handling passenger and freight trains (heavy or light) over long distances and to interurban service with either single cars or multiple-unit trains, although it is only under exceptional circumstances that it may at present be considered economical for street-railway operation in the compact distribution systems of cities and towns.

Transmission and distribution of energy from power plants to moving cars or trains by the single-phase system is simple and economical, and a high efficiency is obtained.

The first great economy of single-phase systems is in the first cost of installation, whether energy be locally generated or purchased. The first cost of rotary converters and intermediate feed wires is dispensed with, and a further saving is effected in first cost of substations. Instead of comparatively large buildings at frequent intervals the single-phase system requires only small substation buildings at long intervals. These need be nothing more than shelters for transformers, and in many cases outdoor transformers may be used.

The second great economy of alternating-current operation is found in the item of fixed charges and operating costs. Since the first cost of apparatus and installation is lower than for direct current the items of depreciation, interest, taxes and insurance are less as a direct consequence.

In operating expense the first saving apparent is that of attendants at substations. The moving machinery required for

conversion to direct-current requires constant attendance, with day and night operators, while the stationary transformers, whether sheltered or standing outdoors, require little attention other than visits at convenient intervals.

In the matter of energy consumption the records obtained from a number of operating companies show that the kw-hours generated per car-mile are considerably lower for single-phase equipments than for direct-current equipments operating cars of the same general dimensions and design, under similar conditions, from a substation-fed trolley.

The first cost and weight of single-phase rolling stock equipment is somewhat greater than that of direct-current apparatus and the maintenance charges are somewhat higher, but the saving in first cost of the complete electrification, fixed charges and operating expenses overbalance these considerations.

From an operating standpoint the single-phase system has numerous favorable features. It is capable of the highest speed and yet the speed control is entirely flexible and unlimited. Any desired variation can also be provided for by transformer taps.

An important feature of advantage for interurban roads and main lines is its adaptability for multiple-unit train operation. A single-phase system laid out with the minimum copper and substation requirements can operate trains of many cars. Among numerous instances it may be mentioned that the Chicago, Lake Shore & South Bend Railway recently operated an eleven-car train, made up of six motor cars and five trailers, for a distance of more than 60 miles over its line without interfering in any way with the regular service maintained. A number of the single-phase roads now in operation regularly operate trains of from two to five cars without having found it necessary to add any feeders to the overhead lines as laid out for single-car operation.

Another advantageous feature is found in the voltage step control of single-phase equipment, in which every speed is an efficient speed. A fact not widely known is that this control renders the equipment much better adapted for bucking snow than the direct-current resistor-equiped car. Last winter the Glen Cove single-phase line of the Long Island (N. Y.) railroad was reported as keeping its schedule when all direct-current lines on Long Island were badly tied up in a heavy snowstorm. All single-phase lines report less trouble than others in snowstorms.

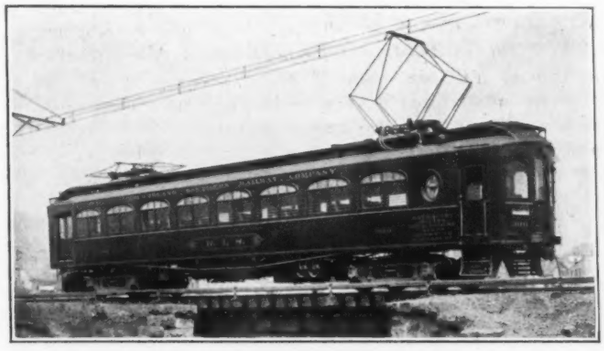


Fig. 1—Single-Phase Motor Car of Rock Island Southern Railway.

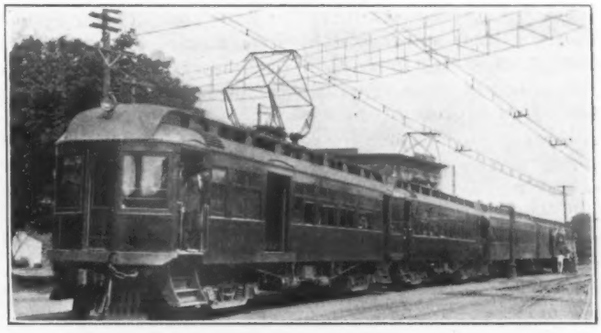


Fig. 2—Single-Phase Train of Erie Railroad.

Opponents of single-phase operation have frequently asserted that it was unsuited to heavy service, and a paper read last summer went so far as to assert that single-phase projects were practically abandoned in America. It was an amusing coincidence that this paper came out just before the Boston & Maine Railroad signed contracts for the single-phase electrification of the Hoosac Tunnel, and that at the same time the New Haven interests ordered additional Westinghouse single-phase locomotives. The New Haven had also, after three years of trial, placed contracts for single-phase electrification of its Harlem River division and has planned to extend single-phase electric operation to all traffic over the whole division between New York and New Haven. At the same time also equipment was being built for an entirely new single-phase interurban line in Illinois (the Rock Island Southern) and other single-phase roads were increasing their equipments. Another notable example is found of thoroughly satisfactory operation of single-phase apparatus in the St. Clair Tunnel, where all of the traffic of the Grand Trunk Railway has been handled electrically for nearly three years.

Recent information shows that, after exhaustive investigation of electric systems, the Prussian government has adopted

Road.	Miles of Road.	Trolley.		Schedule.		Class of Service.
		Voltage.	Cycles.	Local.	Express.	
Chicago, Lake Shore & South Bend Railway	{.... 176	800 6,600	25 25	 33	 65	Freight and interurban passenger
Denver & Interurban Railway R. R. Co.	{54	550 11,000	D.C. 25	 30	....	Steam railroad passengers.
Erie Railroad Co.	34	11,000	25	26	....	Steam railroad passengers.
Ft. Wayne & Springfield	21.6	6,600	25	26.5	45	Interurban passengers and freight
Grand Trunk Railway	....	....	....	....	....	....
St. Clair Tunnel	3.7	3,300	25	10	....	Steam railroad, freight.
Hanover & York Street Railway	18.58	6,600	25	26	....	Interurban passengers and freight.
Indianapolis & Cincinnati Traction Co.	108	3,300	25	37	47.7	Interurban passengers and freight.
Long Island R. R.	4.85	2,200	25	28	....	Suburban passengers.
Maryland Electric Railway	24.93	6,600	25	36	....	Steam railroad passengers.
N. Y., N. H. & H. R. R.	34	11,000	25	26	60	Steam railroad passengers.
Pittsburgh & Butler Street Railway	38	6,600	25	25	50	Interurban passengers and freight.
San Francisco, Vallejo & Napa Valley R. R.	33.84	3,300	25	23	54.5	Interurban passengers and freight.
Spokane & Inland Empire R. R. Co.	130	6,600	25	21	....	Steam railroad, freight and passengers.
Visalia Electric Railway	22.2	3,300	15	31	62	Steam railroad, freight and passengers.
Rock Island & Southern Railway	....	....	25	....	....	Interurban passengers and freight.

single-phase motors with an aggregate rating of 1900 hp and a speed of 74.4 miles per hour for the standard electric locomotive for trunk-line service. The Vienna-Pressburg and another Austrian railroad are now to be operated with 15-cycle, 10,000-volt, single-phase energy, as is also the Rhattisch Mountain Railroad in Switzerland.

From lists recently published in the *Elektrische Kraftbetriebe und Bahnen* of single-phase railways equipped by two of the German manufacturing companies it appears that these companies have equipped thirty-two railways with 433 single-phase locomotives or motor cars of an aggregate horse-power of 206,145, which surely indicates progress and satisfactory performance. In England the London, Brighton & South Coast Railway, 9 miles in length, was equipped with the single-phase system and put it into operation in December, 1909. Its report for the first six months of 1910 shows the enormous increase of 91 per cent in passenger traffic, and the system has been so successful that the company is now reported to have determined upon immediate similar equipment of its entire line of nearly 500 miles of track.

In France the Midi Railway is now equipping some 150 miles of double track on the single-phase system and a few tramway lines are giving it a trial.

Full particulars as to all single-phase railways in America are not at the moment available, but a partial list of roads equipped by the Westinghouse Electric & Manufacturing Company is given in the accompanying table.

Since the single-phase alternating-current series motor operates equally well on direct current some railways have cars and locomotives equipped with control apparatus for both systems, and direct-current trolleys, or third-rail shoes, in addition to the single-phase pantagraph trolley. This arrangement was at first considered to be favorable for single-phase roads, since it permits operation through city streets and elsewhere over the tracks of connecting direct-current roads, and at the same time secures single-phase economy for the main line, but its applications has restrictions.

On main-line railways, where terminal connections render provision for both forms of operation imperative, it is perfectly practicable. This is fully shown in the successful operation of the New York, New Haven & Hartford Railroad, which is obliged to enter the New York City passenger terminal over 12 miles of direct-current electrified line; but where it is not essential it is undesirable and should be avoided. Provsion of double control equipment increases first cost and adds materially to the weight and to the maintenance charges. In some instances where it has been attempted on interurban roads with city connections the weight of the cars has been found detrimental to ordinary tracks in city streets, with a resultant condition of understrains on cars and equipment, but it has been amply demonstrated that single-phase operation over suitable tracks through city streets is entirely satisfactory; and when interurban roads have their own lines through or into cities and towns local and through conditions are equally well served.

The practical success of single-phase current in railway service is now thoroughly proved in so many installations in the United States and abroad that it must soon become familiar to many who have been opposed to its use. Its scope includes practically all of the railway field in which length of line is greater than the few miles that can be served economically from direct-current converters.

SWITCHBOARD FREQUENCY METER.

In the frequency meter here illustrated the principle of operation is based on a Wheatstone bridge arrangement of resistors and reactors which is balanced at only one definite frequency, the degree of unbalance being indicated by a differential meter calibrated to read directly in cycles per second.

The meter is a soft-iron instrument of a special type, consisting of a pivoted iron needle mounted in a magnetic field produced by two flat rectangular coils placed in mechanical space quadrature to each other, as shown in Fig. 2. One of the field coils is connected in series with a resistor across the line, and the other is connected in series with a reactor across the line. A reactor is connected in parallel with the first coil and the resistor, and a resistor is connected in parallel with the second coil and the reactor, and then the entire bridge combination is connected in series with a reactor, the purpose of which is to damp out higher harmonics, and thus render the indications free of errors due to wave distortion. The constants of these circuits are adjusted to give equal current through the coils for some given frequency; that is, the bridge is balanced and there is no current through the lead *A*. Under these conditions the resultant field lies along the diagonal of the square formed by the coils, and the needle aligns itself therewith. Any change in frequency changes the reactance of the reactors and upsets the balance, thus allowing more current through one coil and less through the other. This action causes the resultant field to deflect to one side or the other, depending upon which coil carries more current.

By suitably designing the instrument and properly choosing the constants of the electric circuits, the scale has been made open and uniform. Therefore, it can be read with a fair degree of accuracy from a considerable distance, based entirely upon the relative position of the pointer on the scale.

As may be readily understood from a consideration of the principle of operation of this instrument, the accuracy and reliability of its indications are largely dependent upon the proper design and construction of the reactors used to produce the reactance.

In general appearance the type of reactor used with these frequency meters resembles a core-type transformer. The core is built up of very thin laminations bolted firmly together to prevent vibration and insulated from each other to minimize the eddy currents.

Fig. 1—Interior of Frequency Meter.

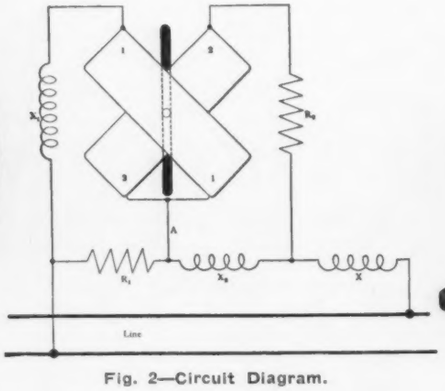


Fig. 2—Circuit Diagram.

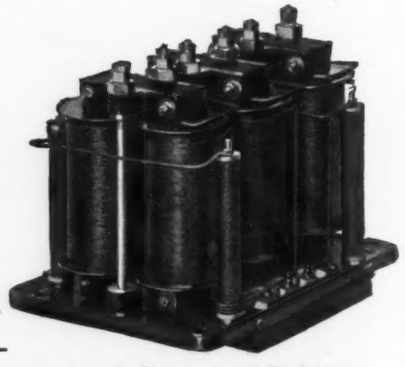


Fig. 3—Reactors and Resistors.

By using a special high-permeability, low-hysteretic alloy core material in conjunction with proper construction, the core losses and temperature errors have been reduced to negligible quantities. The reactance is varied by means of two air-gaps arranged so as to be easily susceptible of precise adjustment. The air-gaps are located in the middle of the exciting coils and thus the shielding action of the coil turns is utilized to prevent the formation of stray or leakage fields, such as would be formed if the air-gaps were entirely outside of the coils. Leakage fields if present would seriously impair the accuracy of the instrument and render it very sensitive to variations in voltage.

This frequency meter is designed for from 110 to 125 volts, but it may be operated at from 75 to 150 volts without introducing a total error greater than 1.5 per cent. The above instrument is manufactured by the Weston Electrical Instrument Company, of Newark, N. J.

WATER AND STEAM FLOW METERS.

In order to use water, steam, gas or electricity economically it is necessary to know not only the amount available by generation or otherwise, but more particularly the amount actually delivered or distributed. While very satisfactory forms of watt-hour meter have been developed for measuring electricity, until recently the devices for measuring steam, gas, water, etc., have not been nearly as accurate. However, several types of flow meter have recently been developed by the General Electric Company. These include both the recording and indicating types—the former making a continuous graphic record of the rate of flow, and the latter giving readings of instantaneous values of the same. The unit of measurement varies with the commodity measured—being pounds per hour for steam, cubic feet per minute for air and gas, and gallons per minute for water.

The recording water flow meter comprises a nozzle plug for

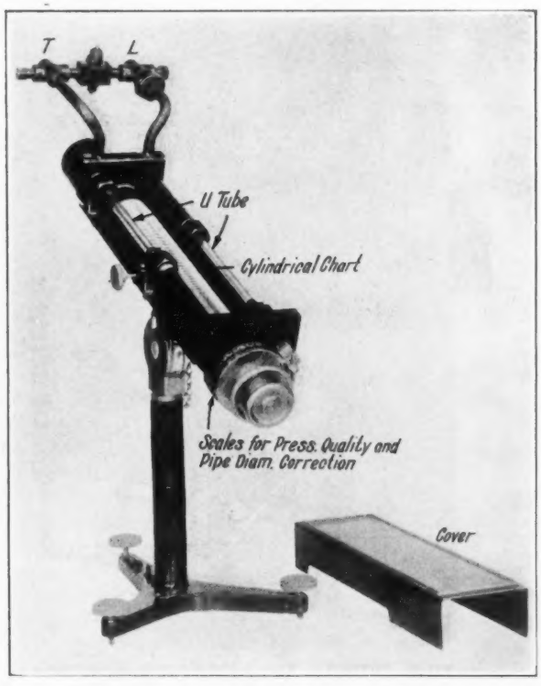


Fig. 1—Indicating Steam Flow Meter.

screwing into the pipe at the point where the flow is to be measured, thus being exposed to the pressure of the water, a meter element which measures the pressure set up in the nozzle plug and a recording mechanism which makes a graphic record of the rate of flow. The nozzle plug has two sets of orifices—the "leading set," located parallel to its axis, extending across the main and facing the direction of flow, and the "trailing set," consisting of three holes located on the opposite side of the plug near the middle and at right angles to its axis. The two sets of orifices open into separate longitudinal chambers lead-

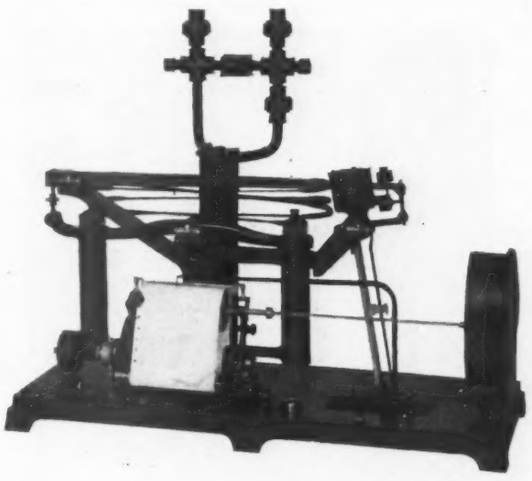


Fig. 2—Recording Water Flow Meter with Automatic Pressure Compensation.

ing to the outer end of the plug. The nozzle plug is suitably arranged for use on either vertical or horizontal mains, and its introduction causes no appreciable drop in static pressure even at very high rates of flow.

When the plug is inserted in the main the water impinging against the orifices of the leading set develops therein a pressure equal to the static pressure plus a pressure due to the velocity head; while the pressure set up in these of the trailing set is equal to the static pressure minus the pressure due to the velocity head, thus causing different pressures in the longitudinal chambers leading to the outer end of the plug. The different pressures are communicated to the motor through suitable pipes attached to the outer end of the plug and connected to flexible steel tubing placed within the meter case.

The meter element consists of two vertical cups or hollow cylinders connected together at the bottom by a tube. The U-tube thus formed is filled with mercury to about half the height of the vertical cups and the whole arrangement is supported and is free to move about a set of knife edges like an accurately constructed balance.

The different pressures in the two sets of orifices in the nozzle plug cause the mercury to rise in the left-hand cup and to fall a corresponding amount in the right-hand cup until the unbalanced mercurial column exactly balances the difference in pressure. This action causes the beam carrying the cups to descend on the left-hand side of the knife edges until the moment of the weights on the right-hand side exactly balances the moment caused by the displacement of the mercury into the left-hand cup. The motion of the beam is multiplied by means of levers and actuates the recording pen, the movement of the latter being proportional to the amount of mercury displaced.

The drum carrying the recording paper is driven by an eight-day clock. The paper is calibrated to record the flow in gallons per minute and the rate of flow may be read at any instant, or the average rate calculated for any given length of time.

The indicating steam flow meter is designed for testing work and other purposes such as locating trouble due to leaks, determining efficiency of boilers, etc., where accurate, instantaneous readings of the rate of flow are desirable. This type of meter operates on the same principle and employs the same type of nozzle plug as the recording meter, but differs considerably in details of construction. It can be readily adjusted for various rates of flow and indicates the instantaneous rate of flow in pounds per square inch of pipe cross-sectional area.

REGULATORS FOR BLOWER MOTORS AT A COKE-OVEN PLANT.

The extended use of the by-products in steel and coke plants requires the solution of a great many new problems in the transmission and control of the power for driving auxiliary machinery in such plants. An interesting installation of this kind is that made for the United States Steel Corporation at Gary, Ind., by the Cutler-Hammer Manufacturing Company, of Milwaukee. In order to use the gas from the large coke ovens for gas engines and get the highest efficiency in the extracting apparatus for the by-products it is necessary that the gas be thoroughly cleaned. During the process of extraction it is also necessary to add certain chemicals to the gas and the amount of these parts must be carefully regulated to permit of best results. The control apparatus installed is for the automatic regulation of the amount of gas which goes into the cleaners. The apparatus after once being adjusted will always supply a constant amount of gas so that the operation may be controlled automatically at the will of the chemist who supervises the operation of the plant.

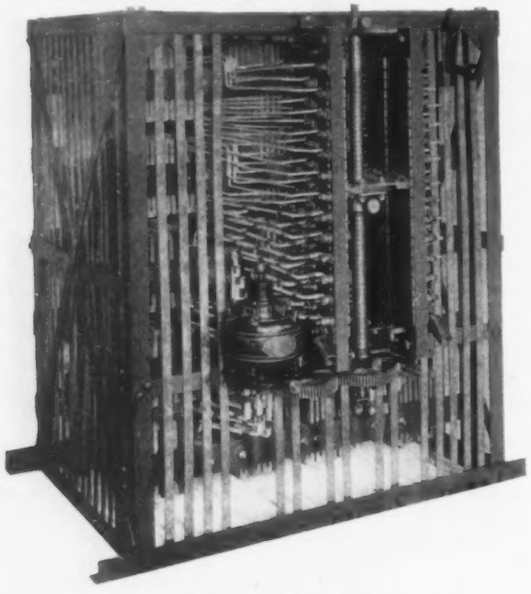


Fig. 2—Motor-Operated Secondary Regulator.

The gas is drawn from the coke ovens and supplied to the cleaners by means of constant-volume blowers. As long as the speed of these blowers is kept constant the amount of gas supplied will of course remain the same even though the pressure on the outlet side should increase, as is actually the case during the process—provided, of course, that the suction remains constant. The alternators in the power house supply energy directly to the auxiliary motors about the plant. It was, therefore, desirable to use alternating-current motors in the present instance.

The amount of gas which can be taken from the coke ovens depends, of course, on the number of ovens in service. In order to adjust the blowers to the number of ovens in service it is necessary to vary the speed of these blowers. It was finally decided to use slip-ring type motors for driving the blowers. There are two groups of such blowers which normally operate in parallel. Each group is divided into three units and the induction motors are arranged for a speed reduction of one-third, so that by running one, two or three blowers the amount of gas drawn from the coke ovens per set can be regulated from two-ninths to full output of the blower set.

In order to have the load equally divided between the blowers it is further necessary that all three blowers run at all times at the same speed relative to each other, and in case it becomes necessary to vary the speed that the speed of the three blowers which work together in one group be changed simultaneously. In order to keep the speed of the induction motors constant it would be constantly necessary for an operator to adjust the regulators in the secondary circuit of the slip-ring type motors. To avoid this unreliable and expensive method an automatic regulator has been designed which operates as follows:

Each motor is controlled by a primary triple-pole circuit-breaker and a motor-operated secondary speed regulator which cuts in and out resistance from the secondary circuit of the motor. A separately excited small generator is mounted on the extended shaft of the blower motors. The field of this generator is excited at a constant voltage and, therefore, the terminal voltage of the generator is proportional to the speed of the big motor. With each set there is also a motor-generator consisting of a squirrel-cage driving motor, a self-excited generator, the purpose of which will be explained later, and three separately excited generators similar to those mounted on the extended shafts of the blower motors. In the field circuits of these latter generators is a regulator mounted on the switch panel by means of which the field strength and, therefore, the terminal voltage may be adjusted at will. These field circuits, as well as the field circuits of the generators on the blower motors, are supplied with current from the self-excited generator of the motor-generator set, which also supplies the power for the driving motors on the secondary regulators. The armatures of the small generators on the motor-generator set and the corresponding armatures on the blower motor shafts are connected in series through a polarized relay, so that in case of any voltage difference at the terminals of the two generators the polarized relay will operate. By means of the field regulators in the small generators of the motor-generator set the terminal voltage of these generators is adjusted to a certain value. Normally the voltage of the generators on the blowers differs from the first mentioned voltage and current, therefore, goes through the polarized relay. This operates the polarized relay and closes the circuit of a reversing relay, which controls the motors on the secondary regulators, and these motors then cut in or out resistance from the secondary circuit of the blower motors until such a speed is obtained

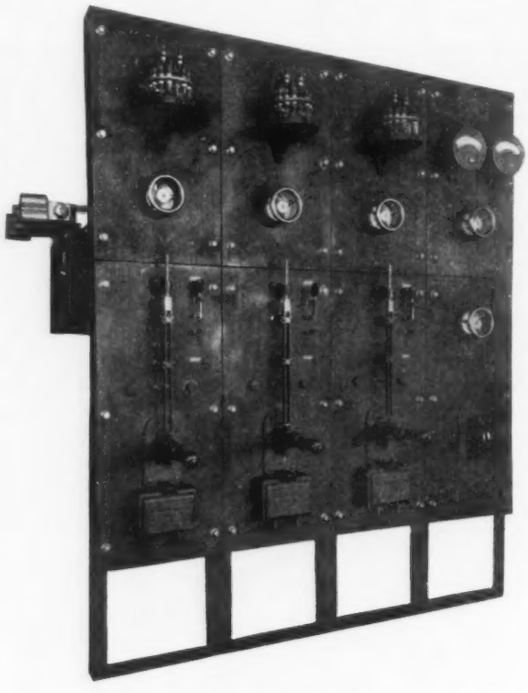


Fig. 2—Control Board for Three 250-hp Slip-Ring Motors.

by the blower motors that the voltage of the generator coupled therewith is equal to the voltage of the corresponding generator on the motor-generator set. If this is the case the polarized relay opens the circuit of the intermediate relay and the motor is de-energized so that the resistance in the secondary circuit of the blower motor remains constant and this blower motor will run at the predetermined speed until the conditions in the system change again. If the load on the blower motor should increase, or decrease, the speed will change correspondingly. This will produce a current in the polarized relay which actuates an intermediary relay and the controller controlling the secondary resistance until this resistance has been adjusted again to correspond to a speed of the blower motor proportionate to the field excitation of the generator of the motor-generator set.

As stated above, it is desired that all three blowers of one set operate at the same speed. For this reason the field currents of the three generators of the motor-generator set are adjusted so that they are equal and then the field excitation of the three generators is changed simultaneously by a field regulator, which is in series with the three parallel field coils. It will, therefore, be seen that when this field regulator is manipulated the field currents of the three generators change simultaneously, so that the three polarized relays are also actuated simultaneously and the secondary regulators regulate the speed

Fig. 3—Rear of Control Board for a Set of Three 250-hp Motors.

of three blower motors to the same value. A voltmeter which indicates the voltage of the generators coupled to the blower motors is calibrated in r.p.m., so that it directly indicates the speed of the three machines.

If it is desired to cut out one or more of the blower motors this is done by a single-pole reversing knife switch, by means of which a resistance equivalent to the field circuit plus the adjusting resistance of the corresponding generator on the motor-generator set is substituted for the latter, so that the total resistance in series with the speed-adjusting regulator remains the same and the remaining blower motors are regulated in the same manner as before.

The regulation possible with this scheme is within 2 per cent of the speed of the motor, closer setting being possible if desired. The primary circuit of the motor is controlled by overload oil switches and the accompanying illustrations show front and rear views of a panel for the control of one set of three motors. The rear view, showing busbar work, is rather complicated on account of the mass of series transformers which had to be crowded into the comparatively small space.

Fig. 3 shows the secondary regulator. This regulator consists of a "cross-head type" commutator front which consists of three sets of segments over which the cross-head with the necessary contact brushes rides. The cross-head is driven by the small direct-current motor described above. The drive from the motor is through a set of gears and a screw so arranged that in case of overtravel the threads come out of engagement and the cross-head stops in its travel without breaking parts of the apparatus and without jamming the motor. The resistors of this regulator consist of banks of cast-iron grids arranged for effective ventilation.

The motor-generator set consists of five machines, as described above. The small generators, which are naturally sensitive to the fumes and gases in the plant, are entirely inclosed and the commutators are inclosed in glass cylinders to make easy inspection possible. The generators mounted on the blowers are also inclosed in a similar manner to prevent corrosion.

The equipment provides for entirely automatic regulation within the range for which it is designed and this regulation is obtained in a strikingly simple manner, considering the accuracy which has to be obtained and the size and number of machines which have to be controlled, as well as the variation in load which is encountered. The load varies from 87 hp per blower at the lowest speed to 250 hp per blower at the highest speed.

ELECTRICAL EQUIPMENT OF CEMENT MILL.

The electrical features of the plant of the Allentown Portland Cement Company, of Evansville, Pa., are of interest in that the plant is typical of the latest cement-mill practice. The mill has an output of 2500 bbl. per day with arrangements for increasing this to 5000 bbl. per day without interrupting production. The operations in the mills and their sequence are as follows:

At the quarry the rock is loaded onto dump cars with a steam shovel. Two hoists, each driven by a 50-hp, wound-rotor motor, take the cars up an incline to the crusher house. The cars discharge into an elevator, which discharges into a No. 10 Gates crusher. This crusher discharges into a second elevator which delivers the material to three No. 6½ Lehigh crushers, where the material is further reduced.

A 250-hp motor supplies the necessary power for the crushing machinery. It is interesting to note here that although individual drive was adopted through almost the entire plant, line shaft was installed in the crusher house. The reason for this is that the load on a gyratory crusher is intermittent and frequently comes on so quickly that it constitutes a severe shock. By using line-shaft drive a shock produced by any particular machine can be absorbed by the inertia of the other machines and moving parts of the system. The discharge from the smaller crushers is lifted to conveyors which carry the material to the large bins adjoining the driers. The storage bins are equipped with automatic shaking feeds, by means of which a constant flow of material to the driers is effected.

A 50-hp squirrel-cage motor is belt-connected to a line shaft from which three 7-ft. x 56-ft. driers are driven. Each drier is connected to the line shaft by belt-drive and the speed is further reduced through two sets of spur gears and one set of bevel gears. Bearing-ring roller idlers are placed sufficiently close together to preclude large bending moments. The 50-hp motor mentioned also supplies power to the shaking feed arrangement from the stock bins to the driers.

From the belt driers the material is carried to the stone storage on a belt conveyor driven by a 40-hp motor. A smaller conveyor driven by the same motor takes the material to the raw mill.

In this mill the material is delivered to two No. 8 Krupp ball

mills, each driven by a 40-hp motor. These mills are used in preparing the mixed raw materials for the Fuller mills. The material is discharged from these ball mills on to several elevators driven from line shafting belted to a 40-hp motor. These elevators distribute the material into a storage bin over the

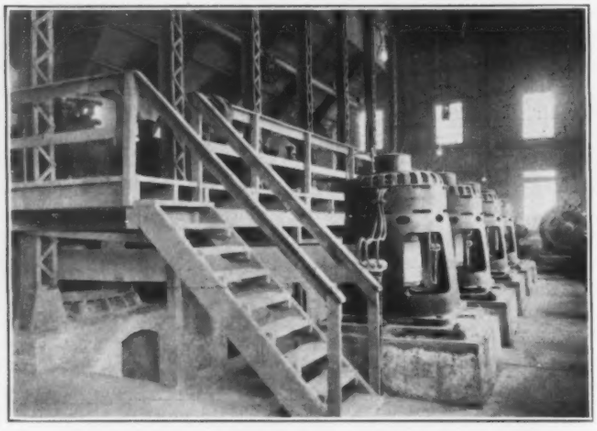


Fig. 1—Vertical Belted Motors Driving Cement Mills.

Fuller mills by means of a screw conveyor. The material is fed from the bin into eight 42-in. Fuller mills, each driven by a 75-hp vertical belted motor. These motors are operating very successfully and have proved distinctly advantageous as compared with horizontal motors with quarter-turn belts. The material is conveyed from the Fuller mills to a large storage bin over the kilns by means of a bucket hoist driven by a 10-hp motor. The material is conveyed into each kiln by an inclined feed pipe which receives its supply from the screw conveyor. There are four kilns, 8 ft. x 120 ft., each driven by a 30-hp variable-speed induction motor.

The coal for firing the kilns is brought from a hopper below the tracks and carried by means of an elevator and conveying system driven by a 40-hp motor to the top of the coal storage. The material is conveyed by gravity into a set of rolls in the pit which reduces the large lumps. An elevator discharges the crushed coal into two 4½-ft. x 30-ft. Matcham driers, from which the material is again elevated and discharged into the bins over the pulverizers. The pulverized coal is carried by a screw conveyor and an elevator to the bins in front of the kilns. One 30-hp induction motor drives the three elevators and the screw conveyor handling crushed and pulverized coal. The pulverizing equipment consists of two 42-in. Fuller Lehigh mills driven by a 75-hp motor. The motor for each kiln is placed in the small pit below the surface of the concrete floor; small openings in which permit the passage of the belt to the pulley on the three-bearing shaft. Further speed reduction is effected through two belts, one bevel-gear and two spur-gear connections.

The speed rotation of the kilns is low, from 1 to 1.5 minutes to the revolution. Provisions must be made in the motor drive to vary the speed of the kiln to suit the charging conditions in burning. In some alternating-current installations, using induction motors, a motor-generator set has been provided to supply direct current for operating the motor for the kilns, but in the plant under discussion alternating-current slip-ring motors with wound secondaries were chosen and have operated with entire satisfaction, the speed changes being obtained by varying the resistance in the secondary of the motor.

Two kilns discharge into a common bucket elevator, which feeds the material into the rotary coolers. There are four coolers operated by a 50-hp motor. The two bucket elevators for these are driven by a 20-hp motor. A belt conveyor takes the material from the coolers and delivers it to an elevator discharging on to a belt conveyor, which distributes the clinker to the storage.

From the storage, where the clinker is permitted to season, it is taken to the gypsum house by means of a belt conveyor driven by a 10-hp motor. An elevator driven by a 10-hp motor takes the material to the finishing mill, where it is discharged into a rotary screen, with 0.75-in. holes. The material which passes through them goes directly to the eight Fuller-Lehigh finishing mills, each of which is driven by a 75-hp vertical-type motor. The coarse material is fed into a No. 8 Krupp ball mill, and the resulting product from the ball mill is discharged into the same elevator that delivers the material to the Fuller mills. The ball mill is driven by a 40-hp motor. Between the rows of finishing mills there are two conveyors discharging into the common elevator that delivers the material to a screw conveyor connecting the finishing mills with the storehouse; this system is driven by a 40-hp motor. Three screw conveyors, driven from a 30-hp motor, carry the material from the bins in the stock house to the bagging house, and a 20-hp motor supplies the power for the elevator that delivers the cement to bins above the baggers. Two pairs of Bates valve-bagging machines are used for bagging the cement, each pair being driven by a 30-hp motor.

Each building has its separate control panel, distribution to which is made from the power house, about 1300 ft. distant, by means of No. 0000 wire. Energy is generated by three Westinghouse 937-kw, 600-volt, three-phase, 25-cycle generators directly connected to Wetherill cross-compound engines. The exciter unit consists of a 150-hp induction motor driving a 100-kw, 125-volt generator; an engine-driven 110-kw, 125-volt generator is provided as a spare. There is a small lighting set consisting of a 110-kw, 600-volt, three-phase, 25-cycle generator driven by a Skinner engine. The twelve-panel switchboard consists of two exciter panels, three main generator panels, a lighting-generator panel, a load panel and five feeder panels.

In a cement plant the power demands are more exacting and the operating conditions are more severe than in other manufacturing processes. The presence of great quantities of highly abrasive dust, the inflammability of the finely powdered coal, the heavy torque required by the machinery and the nature of the load all go to make up a problem in motor drive that requires the most careful consideration for its solution. Induction motors have proved excellent for the purpose. The Allentown Portland Cement Company's plant furnishes one of the best examples of motor drive for cement mills. Great simplicity has been effected in the lay-out of the machinery. Individual drive on the principal machines, including those of burning and

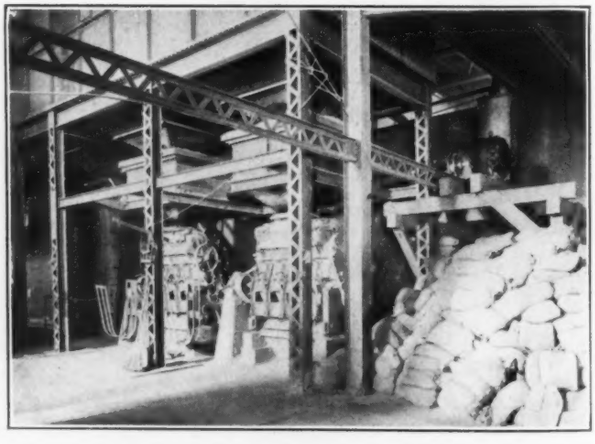
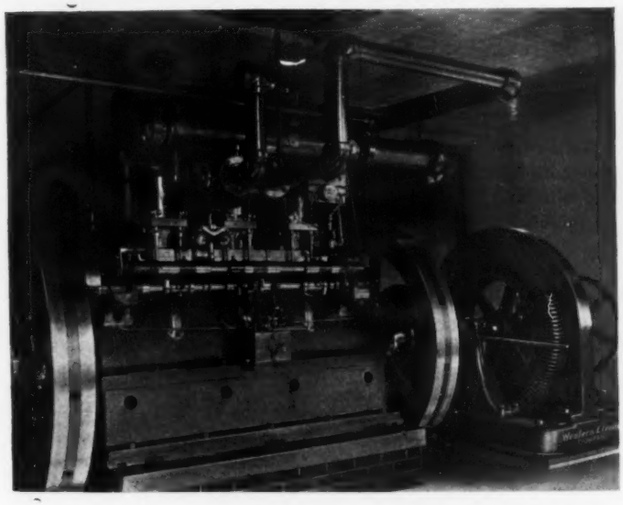


Fig. 2—Motor-Driven Cement-Bagging Machine.

grinding departments, offers the advantage that expensive and troublesome clutches are unnecessary and also that during the shut-down periods of any particular machine the entire friction load of that unit is nil. With line-shaft drive the use of even one machine of a department means a heavy friction load.

A MODERN CENTRAL STATION FOR A SMALL TOWN.

An excellent example of a small, waterwheel-driven central station, with gas-engine auxiliary equipment, is that afforded by the City Electric Light, Heat & Power Company's plant at



View of Central Station, Showing Alternator and Auxiliary Gas-Engine Equipment.

Monticello, Ia. This town received its first electric-light service in 1893, when the Monticello Electric Company was organized. The electrical equipment consisted of a 60-kw, 125-cycle, single-phase alternator and one "twenty-light" arc machine. The plant was driven by waterwheel power furnished from the Maquokita River. Two steam engines were used as auxiliary power.

Last fall the new plant of the City Electric Light, Heat & Power Company was put into operation. This plant was designed by Mr. F. J. Cross, who also controlled the company. On Jan. 1, however, he sold it, and the new management has since bought out the old company, the new plant being the only one now in operation.

The electrical equipment of the present operating plant consists of one 125-kva alternator. Two new waterwheels furnish the power. As an auxiliary source of power a 150-hp Nash gas engine has been installed. This engine is of the vertical three-cylinder type, and operates on producer gas furnished by a Smith automatic gas producer. It is estimated that it will be necessary to operate the producer-gas plant for about three months of the year during the time when the water is low. The gas engine is always ready, however, and in case the wheels are temporarily put out of commission, because of accident or ice jams, it will be found an adequate source of power.

The generator, which is of the Western Electric Hawthorn waterwheel type, is a 2300-volt, 60-cycle machine, so connected that it can be run either by the waterwheels or the gas engine. This is accomplished by providing the generator with a special shaft which extends at both ends. One end is directly connected, through a friction clutch, to the gas-engine shaft, while the other end is directly connected through a similar friction clutch to the shafts of the waterwheels. This arrangement provides a very flexible and efficient combination. The generator can be operated with either one or both of the waterwheels, or by setting the friction clutch on the gas-engine side the combined power of the two wheels and the engine can be obtained.

At present the output of the station consists of a combined lamp and motor load, the peak being about 200 hp. The company has about 250 customers, and close to 5000 lamps are in service. There are also between twenty-five and thirty motors of various sizes on the line. This number is relatively large considering that Monticello is not a manufacturing town. The plant represents an excellent central station for a small town from the standpoints of both operating economy and efficiency. The fact that in a town of only 2100 inhabitants the local company has 250 customers, using 5000 lamps, is a good indication of the success with which day-and-night service has met, and indications point to a still larger list of customers.

NON-SPILLABLE MERCURY WATT-HOUR METER.

In the watt-hour meter here shown the armature floats in the mercury in which it is immersed, a small, solid non-metallic float being riveted to the center of the copper disk in order to give the necessary lifting effect for the weight of the entire moving system, including the immersed armature, the aluminum damping disk and the shaft above, as shown in Fig. 1.

The armature acts like a plunger in a dashpot filled with very heavy liquid, so that it is impossible for any sudden jar or shake to be transmitted to the jewel bearing in such a way as to produce an excessive strain upon it. The mercury chamber element, Fig. 1, is designed somewhat like an invertible inkwell, so that it is impossible to spill mercury, no matter in what position the meter may be turned or placed in shipment or at the time of installation. This is also shown very plainly in Figs. 2 and 3. The shaft of the meter is made in two parts, the lower one, which carries the armature, passing up through the sapphire guide ring in the long shell projecting down from the cover of the mercury chamber, while the upper and larger shaft, which carries the damping disk and the worm for driving the recording train, is keyed freely to the lower shaft, being thus properly driven from the armature. The ring jewel guide is very accurately gaged to give a clearance of about 0.001 in. to 0.002 in. on the armature shaft. The non-spillable feature of the mercury flotation meter renders it especially desirable for use in street-car and similar service where the meter will be subjected to excessive shocks and jars. The meter is manufactured by the Sangamo Electric Company, Springfield, Ill.

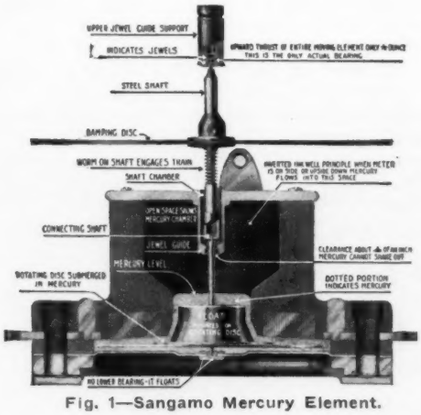


Fig. 1—Sangamo Mercury Element.

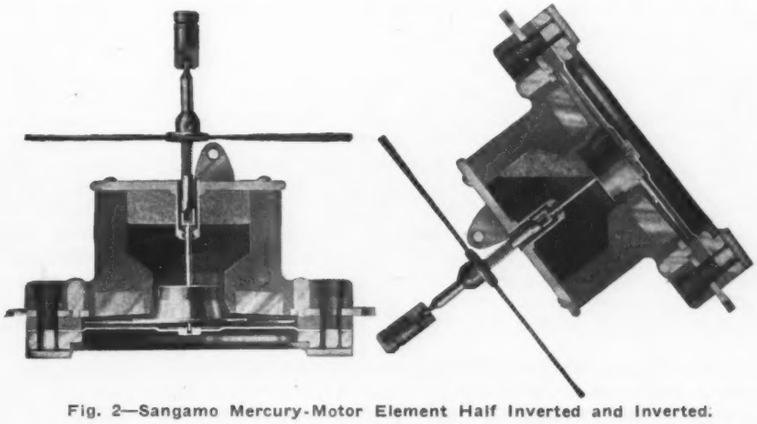


Fig. 2—Sangamo Mercury-Motor Element Half Inverted and Inverted.

Industrial and Commercial News

The Week in Trade.

WITH only casual interest shown in the price shading of a few commodities, no increase has occurred in the actual turn-over, and business in general seems quieter than in the preceding week. Retail demand for furnishings has receded on account of the change in the weather, with a reaction upon wholesale and jobbing trades. Metal markets continue dull, and demand for iron and steel is reported still further decreased. The prospects for structural steel are said to be good, particularly in the East, but present business is not heavy. Pig-iron production in April was 4 per cent under that of March, and foundry business is quiet, with likelihood of further dullness on account of the machinist strike. A feature of the week was a resolution in Congress for investigation of the Steel Corporation and the sugar and woolen trusts. Although ultimate good may possibly come from these probings, there is a strong feeling that the present situation has not been benefited by this additional agitation. The tariff legislation is exerting a retarding effect upon the trade of the country, for with a prospect of lower duties and decreased prices, there is but slight disposition on the part of buyers or manufacturers to commit themselves for later on. The Supreme Court decisions are expected in many quarters before the recess, with the more optimistic expecting early activity to follow. However, with many of these uncertainties removed trade will be in a position for rational advancement. Stock markets have been a shade more active during the week, and bonds continue to be in demand at higher levels. Western interests are said to be feeling more ill effects of the Eastern depression than heretofore, and in spite of the large harvests expected, the buying in the great farming sections is not on a plane with that of previous seasons. Collections are slow to fair. Business failures for the week ended May 4, as reported by *Bradstreet's*, were 234, as compared with 240 for the previous week, 191 for the same week in 1910, 214 in 1909, 288 in 1908, and 154 in 1907.

The Copper Market.

VOLUME of new business during the week was much smaller than that of the week preceding, and the market has shown a decidedly weaker tone. Some price concessions are reported to have been made, resulting in a few small sales of electrolytic for June and July shipment at prices approaching 12 cents, delivered. There has been mild speculation both in this country and abroad during the week, and although prices have varied, the net declines registered for the week are not important. Active demand is practically over for the season as regards this country, and little new business is being obtained from wire drawers or electrical companies. Output, despite the light demand, continues to be approximately 4,000,000 pounds per day, offering no encouraging feature for satisfactory business. Contrary to expectations in some quarters for a decreased surplus in April, the report of the Copper Producers' Association for the month showed an increase in the surplus supply of 3,548,000 pounds, which makes the total surplus the largest since August, 1910. Deliveries showed a loss in April of 10,624,000 pounds, as compared with the showing in March, and this decrease offsets the slight curtailment in production. In view of the increased stocks shown at the end of the month and the decreased demand expected from now on, the likelihood of enforced curtailment in production becomes of greater moment. The situation may be bettered ultimately if the Amalgamated interests abandon the plan of setting fixed prices and assist in the establishment of an open market.

The exports for the month, including May 8, were 7,328 tons. The daily call on the Metal Exchange, May 8, quoted copper as per the accompanying table.

Standard Copper.	Bid.	Asked.	Settling Price.
Spot	11.60	11.70	....
May	11.60	11.70	11.65
June	11.65	11.75	11.70
July	11.65	11.75	11.70
Aug.	11.65	11.75	11.70

The London market, May 8, was as follows:	Noon. £	s	d	Closing. £	s	d
Standard copper, spot	54	0	0	53	18	9
Standard copper, futures	54	11	3	54	11	3

Extreme fluctuations for this year:	Highest.			Lowest.		
Standard	12.30			11.65		
London, spot	£56	15	0	£53	11	3
London, futures	57	12	6	54	3	9
Best selected	60	5	0	57	5	0

Industrial and Commercial Notes.

Southern California Edison's New Station.—The Southern California Edison Company is now building a power station at Long Beach, Los Angeles County, California, in which will be located a 12,000-kw steam turbine unit. The new station will operate in conjunction with the company's other plants, which consist of six hydraulic developments and one other large steam auxiliary supplying power in the counties of Los Angeles, San Bernardino, Riverside and Orange. The ultimate capacity of the station is not decided upon at the present time, but buildings and foundations are designed to provide for a duplicate of the equipment now being installed. The general layout is on the "unit" system, so that the plant may be extended indefinitely as such extension becomes justifiable, the company having purchased a parcel of land comprising about ten acres with this object in view. The site is considered to be a most advantageous one for many reasons, principally, however, on account of its location, which borders on the entrance to what is known as the Long Beach Inner Harbor. This channel will be used to provide water for condensing purposes, supplying all of the sea water which will be required, and at this location the works will not be subjected to the violence which would be offered if they were located on the open beach. There are eight boilers of the Stirling type to be installed, each of which will deliver continuously 30,000 lb. of steam per hour at 225 lb. pressure and 125 deg. superheat. For the entire present installation this evaporation is at the rate of 2880 tons of water per day. Crude oil will be used for fuel, and a large storage tank of concrete will be provided. Auxiliary tanks will be located adjacent to the boiler room, so that the oil pumps for each unit may be relatively near their source of supply. The oil will be received either in tank cars or through an oil main which passes the company's property. The switchboard is to be located in the generator building, although the transformers and switches are to be installed in the transformer house. Electricity will be generated at 11,000 volts, and a part of the energy will be distributed at this voltage, although the transformers will provide for transformation to 30,000 volts and 60,000 volts, and the long-distance transmission will be accomplished at the latter voltage. Double busbar systems are provided throughout for 11,000, 30,000 and 60,000-volt circuits. Frederick Sargent, of Chicago, has been retained as consulting mechanical engineer. The Southern California Edison Company's engineering department is supervising the construction work, and has made all of the designs and plans except the architectural details, which were designed by Parkinson & Bergstrom, of Los Angeles, who have been retained as consulting architects.

Berkshire Street Railway Changes.—Charles S. Mellen, president of the New York, New Haven & Hartford Railroad, has succeeded Lucius S. Storrs as president of the Berkshire Street Railway Company. The New Haven road purchased the Berkshire interests last year, and is reorganizing the street-railway system. C. O. Richmond becomes vice-president. The directors of the Berkshire Railway Company are now as follows: William L. Adams, Pittsfield, Mass.; Charles F. Brooker, Ansonia, Conn.; Timothy E. Byrnes, Boston; Frank Curtis, Sheffield; William Skinner, Holyoke, Mass.; Charles S. Mellen, Stockbridge, and Robert Tytus, of Tyringham. The officers are: Charles S. Mellen, president; C. O. Richmond, vice-president; Augustus S. May, treasurer; H. M. Kochersperger, controller.

Doherty Interests Hold Convention in New York.—Representatives of a large number of bond and banking houses, both in this country and in Canada, attended a convention in New York May 3 and 4, under the auspices of Henry L. Doherty & Co., for the purpose of discussing the present status of public utilities and methods of increasing interest in their securities. The condition of general trade was discussed, and it was generally conceded that the present dullness and absence of public interest in speculative markets would result in a continuation of the abundance of idle funds and the present low rates in the money market. This condition was felt to be decidedly favorable for increasing public interest in the offers of public utility companies as a source of conservative investment. The prospects for increased activity in general trade in the near future were not considered especially bright, in view of the approach of summer and the disquieting influence to be expected from the next Presidential campaign. The conservative attitude held at present by the larger interests was considered as an indication that there will be few large developments in general trade until many of the present uncertainties are dispelled. The hesitancy of investors in purchasing securities was attributed, in a large measure, to the many government and State investigations into the affairs of the larger corporations, and also to the delay of the Supreme Court in rendering decisions in the Standard Oil and American Tobacco cases. A large number of those present considered that adverse decisions would have a favorable effect upon the investment markets, particularly in the sale of securities of the larger gas and electric companies. The point was made that the latter are not classified as combinations which operate in restraint of trade, for, although a great many interests are merged under the one control, the operations are distributed in most cases over the entire country. In spite of the quietness which has been observed in general trade during the past few months it was noted that public utilities have continued to show improvement throughout the period of depression, owing to the fact that the commodities which they furnish are in demand the major portion of the time, and that with increased population the return to these companies is correspondingly increased.

Oil Engine Industry.—There is an increasing demand from small central stations, and from farming, irrigation and manufacturing localities when central-station service is not available, for small oil engine-generator units. While the initial cost of these engines is usually slightly larger than that of gas engines, the manufacturers claim that good fuel economy and simplicity of operation offset the additional cost. Mietz & Weiss, 128 Mott Street, New York, manufacturers of the Mietz & Weiss oil engines, state that demand has been very brisk recently and that large sales are expected. They have recently filled an order for the government for twelve Mietz & Weiss distant-control engines for use in connection with wireless equipment, and are now building six additional engines for the same service. A large number of machines have been sold to South and Central American interests, and throughout Europe. Recent engine sales which the firm has made are: One 100-hp engine to the town of Andover, Mass.; one 100-hp to the town of Spencer, Ia.; one 100-hp to the town of Gregory, S. D.; one 150-hp to the Croton Falls electric-light plant, Croton Falls, N. Y.; 130-hp to the 'Frisco Mines & Power Company, Kingman, Ariz.; 75-hp to C. W. Hunt Company, West Brighton, N. Y.; 64-hp to the town of Medway, Mass.; 50-hp to the Albion Electric Light & Power Company, Albion, Neb.; 75-hp to the town of Walthill, Neb., and 50-hp to the Gibbon Electric Light Company, Gibbon, Neb.

Anglo-American Cable Service.—With the return of President Vail, of the American Telephone & Telegraph Company and the Western Union Telegraph Company, from London this week full details are expected of the terms of the agreement by which these companies and the Anglo-American Cable Company will co-operate in furnishing transatlantic service. The preliminary steps in this matter were described in the *Electrical World*, June 20, 1910. The outline of the plan as understood in this country is that the companies will be operated under American management, and that the English interests are to receive each year a fixed guarantee amounting to 3¾ per cent upon the total capital stock of $35,000,000. The agreement will have to be ratified by the stockholders of the English company, and until this is done the details may not be made public. The transaction will give the Western Union Company control of eight Atlantic cables and will afford a means of better service to the public at reduced rates, and furnish increased returns to the companies. Under present conditions the cable service experiences a daily peak load in business hours, this load being of short duration owing to the difference in time between this country and England. At other times the cables are very lightly loaded, service being furnished chiefly for journalistic and personal messages. The new arrangement is an outcome of the success of the day and night letter plan of the Western Union, and is to be operated on a similar basis.

St. Louis Company Opposes Ordinance.—The Union Electric Light & Power Company, of St. Louis, has brought a suit before the city to enjoin it against enforcing the recent ordinance of the City Council which reduces the price of current for dwellings from 12 cents to 9½ cents per kw-hour. The company gives five reasons for the injunction, stating that a price of 9½ cents per kw-hour as a maximum does not give a proper return on the investment entailed in furnishing the service; that the requirements of the ordinance for free meters, discontinuance of deposits, removal of charge for installation of service and limiting the term of contracts to one month as a maximum are unreasonable; that the Public Service Commission, which recommended the lowering of prices, undervalued the properties of the company; that the city has no authority to establish rates, and that the present rate of 12 cents per kw-hour is just. A. S. Miller, president of the company, is preparing to sever his connection with the company, and A. C. Einstein, of St. Louis, president of the Suburban Electric Light & Power Company, the King Electric Company and the St. Louis County Gas Company, may be elected to succeed him. Mr. Miller plans to take up consulting engineering work in New York.

Cuban Telephone Service Increasing.—W. M. Talbott, president of the Cuban Telephone Company, which is an American concern with English and American capital, says that telephone business on the island is rapidly increasing, that over 6,000 telephones are now in use, and that the company is now installing long-distance lines. Mr. Talbott attributes the success of the company to the improved service in the last few years. The automatic telephone, requiring no operators, is in use. The company gives unlimited service, and the rate depends on the class of telephone, the charge for an office telephone being $84 per year, and a residence telephone $60. The company is installing 1200 miles of pole line throughout the island, and expects to have this completed within two years. A new local system is being completed at Cienfuegos, and it is expected that the provinces of Matanzas and Santa Clara will be connected with Havana by the first of the year. Mr. Talbott adds that the franchises for local services are held under old Spanish grants on limited periods, that these are now expiring, and that the company is replacing old systems in the various towns in succession. The hard woods of the island are used for poles.

Electrical Construction.—Among the items printed under Construction News in our present issue are announcements of proposed new plants or considerable extensions to present plants at Sterling, Mass.; Cumberland Gap, Tenn.; Mankato, Minn.; Ann Arbor, Mich.; Custer, S. D.; Waynoka, Okla.; West Palm Beach, Fla.; Shreveport, La.; Minneapolis, Minn.; Seattle, Wash.; Barnett, Va.; Dayton, Ohio; Canton, Ohio; Anamosa, Ia.; Columbia, Mo.; Rockville Centre, N. Y.; Holyoke, Mass.; Oklahoma City, Okla.; San Francisco, Cal., and Gibson City, Ill.

Cheap Fare for Jones & Laughlin Employees.—The Jones & Laughlin Steel Company has awarded contracts to J. C. McGuire & Company, of New Brighton, Pa., for the construction of a street railway between Woodlawn, New Sheffield and their new Aliquippa Works. The road is to be known as the Woodlawn & Southern Street Railway Company, and will be built for the benefit of workmen at the Jones & Laughlin plant. The fare will be 2½ cents, and will be the lowest in the State.

Westinghouse Company to Enlarge Plant.—A pattern shop is to be added during the year to the foundry plant of the Westinghouse Electric & Manufacturing Company at Trafford City, Pa., and a foundry for turning out large castings will also be erected. When completed the Trafford City plant will handle the entire foundry work of the company, employing in the neighborhood of 3000 men.

Northern Ohio Traction & Light Company.—Announcement has been made that the capital stock of the Northern Ohio Traction & Light Company has been increased by $3,000,000 preferred stock.

Financial.

The Week in Wall Street.

BOND transactions continue to be the sustaining element of the New York market, and the sales of the past week have not only been greatly in excess of the good showing of the week preceding, but have been the largest since the beginning of the year. Total transactions amounted to $25,151,000, comparing with $12,786,000 for the first week in May, 1910, and with $23,730,000 in the last week of January, 1911, the largest week up to the present. This active trading is encouraging not only in its volume, but also in the extending of the demand to the lower grades of securities, in addition to the demand for the higher-grade issues which were the features of the initial activity. This wider scope is held to indicate, in the Street, that not only is investment being sought for idle funds, but that the purchasing of nearly all classes of securities serves to show a return of public confidence. The trading in stocks has not shown any notable change in activity, in spite of the condition of the bond market, but the time is yet too short for the influence of the bond market to be of benefit in this quarter. Sales for the week were 2,269,399, compared with 1,725,941 for the previous week. The belief is entertained by many business men of standing and experience that returning activity will be accompanied by far more conservative business methods than those of the past, due to a change in human nature they believe to be an underlying factor in present conditions.

NEW YORK.

	May 1.	May 8.	Shares Sold.		May 1.	May 8.	Shares Sold.
All. Ch.....	7½*	7½	10	Int. Met., pf.	51⅞	53¼	10,250
All. Ch. pf...	28	27	600	Mackay Cos..	90½*	90½	20
Amal. Cop...	63⅞	63	38,800	Mackay C.,pf.	74⅞*	75⅝*	800
Am. D. T...	20½*	20½*	———	Man. Elev..	136*	135*	415
Am. Loco....	38	38*	500	Met. St. Ry.	15*	15*	———
Am. Loco., pf.	104⅞*	104⅞*	———	N.Y.&N.J.Tel.	139½*	139½*	———
Am. Tel. & C.	83*	82½*	300	Steel, com...	76¾	74½	400,510
Am. T. & T..	146½	148⅞	17,100	Steel, pfd....	119¼	119	5,150
B. R. T.....	79⅛	78¾	28,890	W. U. T....	73¾	74½	14,060
Gen. Elec....	159	156¼	6,630	West'h, com..	69	68*	2,200
Int. Met.....	18¼	19	6,350	West'h, pfd.	117½	117*	———

PHILADELPHIA.

	May 1.	May 8.		May 1.	May 8.
Am. Rys.....	44	44	Phila. Elec.....	16½	16½
El. Co. of A.....	12*	12*	Phila. R. T.....	18	17¼*
Elec. St. B'ty.....	52¾	52¾*	Phila. Trac.....	82¼	82½
Elec. St. B'ty., pfd.	30*	30*	Union Trac.....	46	45¾

CHICAGO.

	May 1.	May 8.		May 1.	May 8.
Chi. City Ry.....	186*	186*	Chi. Tel. Co.....	121	124*
Chi. Rs., Ser. 1.....	80*	80*	Met. El. Co.....	22⅛*	22⅛*
Chi. Rs., Ser. 2.....	22*	21¾	Met. El., pfd.....	67*	67¼
Com. Edison.....	125	125*	Nat'l Car.....	114*	115
Chi. Subways.....	5¼	4⅞	Nat'l Car, pfd.....	120*	120*

BOSTON.

	May 1.	May 8.		May 1.	May 8.
Am. T. & T.....	146½	148¾	Mex. Tel.....	4½	4*
Cum. Tel.....	150*	150*	Mex. Tel., pfd.....	6½*	6¼*
Edison E. Ill.....	286*	287¼	N. E. Tel.....	142¾	143
Gen. Elec.....	158	157	W. T. & T.....	19½	20¼*
Mass. E. Ry.....	18¾	18½	W. T. & T., pd.....	94	94½*
Mass. E. Ry., pf....	88	88			

*Last price quoted.
Shares sold for week May 1 to May 6.

Money markets have not been greatly changed by the activity of the bond market, and rates are practically the same as last reported. Rates May 8 were: Call, 2@2¼ per cent; ninety days, 2½@2¾ per cent. The quotations in the table are those at the close May 8.

Financial Notes

Pacific Gas & Electric Company for 1910.—In the annual report of the Pacific Gas & Electric Company for 1910 an increase in returns for the year and for the past five years is shown. Gross revenue in 1910 was $14,229,228, of which $369,264 is in suspense owing to the San Francisco rate cases. The undisputed gross revenue is therefore $13,859,963, which is $527,462 more than the earnings in 1909. The amount charged to maintenance was $1,243,859, and to operating expenses, taxes, reserve for uncollectible accounts, casualties, etc., was $6,677,481, making total expenses for the year of $7,921,341. Net revenue was $5,938,622, and interest charges $3,006,156, leaving a balance of $2,932,466, as compared with $2,812,403 in 1909. Total deductions, including dividends of $600,000 on preferred stock, $733,402 applied to sinking funds and $47,220 for amortization of bond discount and expense, left a balance of $1,551,844, against $1,502,956 for the previous year. The report states that in 1906 61.5 per cent of the net revenue was required to meet fixed charges, while in 1910 50.6 per cent was required for this purpose, and that while over $17,000,000 has been spent on additions to plant in the last five years there has been only a slight increase in fixed charges. In 1906 the average rate of interest paid on obligations was 5.10 per cent, against 4.98 per cent in 1910. During the five years retirement or cancellation of bonds aggregated $2,513,405, and further, bonds with par value of $1,140,000 were purchased for sinking funds, but not canceled. The company serves over 100 communities in California. On Dec. 31 there were 240,934 customers, of which 82,721 purchased electric service; 152,403 gas; 5110 water for domestic uses, and 700 took water for irrigation purposes. The output of the stations in 1910 was 366,867,336 kw-hours, and the passengers carried on the street-railway system in Sacramento were 10,691,475, earnings per car mile being 23.3 cents.

Northern Texas Electric Company.—Estabrook & Company and Parkinson & Burr have purchased $1,000,000 three-year 5 per cent coupon notes of the Northern Texas Electric Company. These are the direct obligation of the Northern Texas Electric Company, and are to be secured by a first mortgage upon the property of the Ft. Worth Southern Traction Company, which is to be organized under the laws of Texas, and the greater portion of whose stock will be owned by the Northern Texas company. The Ft. Worth Southern Traction Company will operate an electric railway, some 30 miles in length, between Ft. Worth and Cleburne, Tex. A balance of $428,559, available for interest on the notes is shown in the earning statement of the Northern Texas Electric Company for the year ended Jan. 31, 1911, amounting to over eight times the $50,000 required. The notes are being offered by the bankers at 99 and interest, to yield 5⅜ per cent.

Mutual Union Telegraph Bonds Extended.—The $5,000,000 first-mortgage thirty-year 6 per cent bonds of the Mutual Union Telegraph Company, a subsidiary of the Western Union Telegraph Company, matured May 1, and holders were offered the privilege of receiving cash for them at par or exchanging for a new issue of 5 per cent thirty-year bonds at par. Most of the holders took the new bonds, and others, holding about $1,000,000, cashed in their bonds at the Chase National Bank, which acted for Blodget & Company, a bond house, which had purchased from the Western Union the right of extension for its own account. The Western Union, which owns nearly all of the $2,500,000 stock of the Mutual Union Company, held $3,043,000 of the maturing bonds for which the new 5 per cent issue was exchanged.

Great Western Power Company Extension.—Negotiations for the purchase of the City Electric Company, of San Francisco, by the Great Western Power Company, as reported in the issue of April 6, are being brought to a close. Edwin Hawley, president of the Great Western company, has sold securities of this company to a banking syndicate, and $4,000,000 of the proceeds therefrom will be used to acquire the properties and interests of the City Electric Company. After the merger the plants of the City Electric Company will be connected with those of the purchaser.

Kellogg Switchboard & Supply Company.—The first financial statement of the Kellogg Switchboard & Supply Company has been made public and shows plant and equipment assets amount to $744,864, which does not include either patents held by the company or any valuation of good-will. Inventories are given as $1,071,198, and the capital stock as $1,000,000, with a surplus of $1,211,728 after payment of the year's dividends.

Hudson Companies' Notes Offered.—Harvey Fisk & Sons, of New York, are offering $1,000,000 Hudson Companies 6 per cent secured convertible gold coupon notes. These are a portion of the issue of $10,136,000 sold in 1910, and are secured by a deposit of the trustee of 150 per cent of Hudson & Manhattan Company first-mortgage 4½ per cent bonds, due 1957. The notes are offered at 98½ and accrued interest.

Indianapolis & Louisville Reorganization.—The reorganization plan of the Indianapolis & Louisville Traction Company, which is to be disposed of by foreclosure sale, has been completed, and includes the issuing of new securities as follows: Five per cent thirty-year first mortgage bonds to the amount of $10,500,000, and $600,000 6 per cent cumulative preferred stock, and $600,000 common stock.

Tri-City Railway & Light Company.—President Joseph F. Porter, of the Tri-City Railway & Light Company, which furnishes traction, lighting and motor service at Davenport, Ia., Rock Island and Moline, Ill., says in his annual report that the affairs of the company are in a very satisfactory condition. The gross earnings for the year were $2,513,486, representing an increase of 23.24 per cent over the figures of the previous year. Net earnings were $1,031,519, an increase of 14.8 per cent. Operating expenses and taxes also increased, and amounted to $1,481,967, this amount being nearly 30 per cent higher than in 1909. Deducting interest charges and sinking-fund instalments, there was left a surplus for the year of $550,111, from which dividends amounting to $169,572 were paid on the preferred stock. After total deductions there was left a net surplus for the year of $330,539. In the spring of 1910, the company's railway department secured from the authorities in each of the three cities extensions of franchise rights for a period of twenty years on the Illinois side and twenty-five years on the Iowa side, covering existing tracks and privileges for new extensions. The franchises of the electric companies on the Iowa and Illinois sides of the river now extend into 1935 and 1943 respectively. President Porter states that conditions contingent upon extensions are not burdensome. One of the more important requirements for extension is the placing of feeders in conduits below the surface of the streets in the fire district of Davenport, and this work is reported as progressing rapidly. The company's lines are being constantly extended into the outlying districts in order to reach new customers, and during the year the company has been successful in securing a considerable increase in its load. Various improvements have been made during the year in the stations of the company.

New England Telephone & Telegraph Company.—The annual report of the New England Telephone & Telegraph Company for the year 1910, which has recently been issued, gives gross earnings as $13,171,709, compared with $12,086,782 for the previous year. Total expenses for the year were $9,858,907, and interest charges were $118,808, leaving net earnings of $3,193,994, as compared with $3,183,949 for 1909. Dividends amounted to $2,350,686, leaving a surplus of $843,308. The total number of stations of the New England Telephone Company, Dec. 31, 1910, was as follows: Exchange, 253,795; private line, 5307. For the Southern Massachusetts Telephone Company, exchange, 27,740, and private line, 197. Stations for associate and connected companies were 54,983, making a total of 382,022, an increase of 37,106 stations for the year. There were 734,204 miles in wire, and 10,153 employees. The company announces its decision to give a complete and impartial trial to the schedule of rates for the Boston & Suburban Division recommended Aug. 23 by the Massachusetts Highway Commission. Expenditures for 1911 are estimated at $4,000,000 for new construction and real estate, and $4,400,000 for repairs and depreciation, making a total of $8,400,000.

Ohio Electric Road Insolvent.—United States Judge J. M. Killits has appointed Albert E. Royce and Burton C. Harding, of Bowling Green, Ohio, receivers of the Lake Erie, Bowling Green & Napoleon Railway Company, following the application of Edmund C. Ebert, of Detroit. Mr. Ebert alleges that the company is insolvent and defaulted interest May 1 on $400,000 of its authorized bond issue. The Union Trust Company, of Detroit, is a defendant in the suit. The receivers will take immediate control of the properties of the road, including the lighting plant and hot-water-heating system. The company has been operating the railway between Bowling Green, Pemberville, Woodville and Tontogany, and has made plans for further extension. The company has $750,000 common stock, of which $380,400 is outstanding, and has $250,000 preferred stock, which is outstanding. There are also $1,000,000 5 per cent first mortgage gold bonds, dated Nov. 1, 1903, due Nov. 1, 1913.

Conversion of General Electric Bonds.—Plans have been completed for the conversion of the General Electric Company's $12,875,000 5 per cent ten-year gold debenture bonds of 1907 into stock at par after June 1. With the stock now earning 8 per cent and the bonds 5 per cent, it is expected that the entire issue will be converted. This would make the capital stock of the company $78,054,600, against a capital stock of $65,179,600 on December 31, 1919, and would relieve the General Electric Company of bonded debt, with the exception of $2,047,000 3½ per cent gold debenture thirty-year convertibles of 1892. There are also $1,912,066 5 per cent bonds authorized but not issued. In view of the excellent showing made by the company last year, a number of stockholders have asked for a higher rate of dividend, but action in this matter will doubtless be deferred until the conversion of the bonds is effected.

Bell Telephone Company to Acquire Southern Interests.—Negotiations are said to be under way for the purchase of the Central Home Telephone Company of Kentucky by Bell Telephone interests. A board of trustees of bondholders and creditors, under an agreement between the Central Home Telephone Company, the Mobile Telephone Company and the Independent Long Distance Telephone Company, is now in charge of the affairs of the Central Home company.

McCall's Ferry Transmission Line.—The Susquehanna Transmission Company is planning to issue $1,131,000 first-mortgage 5 per cent bonds to meet the expense of its transmission line from the McCall's Ferry plant of the Pennsylvania Water & Power Company to Baltimore. Construction of the line is nearly finished, and the balance of the work will require an expenditure of some $200,000.

Ohio Lighting Companies Merged.—The Hardin-Wyandotte Lighting Company has absorbed the lighting plants at Forest, Dunkirk, Kenton and Upper Sandusky, Ohio, and has filed a mortgage at Upper Sandusky, securing a $500,000 bond issue in favor of the Citizens' Savings & Trust Company of Cleveland.

Dividends

General Electric Company, quarterly, $2 per share, payable July 15.

Kings County Electric Light & Power Company, quarterly, 2 per cent, payable June 1.

Mobile Electric Company, quarterly, preferred, 1¾ per cent, payable May 15.

Portland Railway, Light & Power Company, quarterly, $1 per share, payable May 12.

Tampa Electric Company, quarterly, $2 per share, payable May 15.

St. Joseph Railway, Light, Heat & Power Company, quarterly, one-half of 1 per cent, payable June 1.

West Pennsylvania Traction Company, quarterly, 1 per cent, payable June 15.

REPORTS OF EARNINGS.

	Gross Earnings.	Operating Expenses.	Net Earnings.	Fixed Charges.	Net Surplus.
AMERICAN LIGHT & TRACTION COMPANY.					
12m., Mar., 1911	$3,933,091	$119,521	$3,813,569	.....	.....
12m., Mar. 1910	3,463,580	107,445	3,356,135	.....	.....
BLACKSTONE VALLEY GAS & ELECTRIC COMPANY.					
March, 1911	$86,986	$46,951	$40,045	$29,705	$10,340
March, 1910	81,458	39,707	41,751	29,165	12,586
DALLAS ELECTRIC CORPORATION.					
March, 1911	$129,528	$83,936	$45,592	$27,616	$17,976
March, 1910	114,849	77,241	37,608	26,347	11,261
DETROIT UNITED RAILWAYS COMPANY.					
March, 1911	$772,719	$490,269	$298,058	$177,567	$120,491
March, 1910	725,233	470,407	266,900	161,871	105,029
EL PASO ELECTRIC COMPANY.					
March, 1911	$57,090	$32,720	$24,370	$8,247	$16,123
March, 1910	51,579	29,564	22,015	8,575	13,440
GALVESTON-HOUSTON ELECTRIC COMPANY.					
March, 1911	$116,287	$70,985	$45,302	$24,682	$20,620
March, 1910	105,144	67,673	37,471	23,080	14,391
ILLINOIS TRACTION COMPANY.					
Year, 1910	$6,218,037	$3,665,627	$2,498,226	$1,536,687	$961,539
Year, 1909	5,363,383	3,063,491	1,927,263	1,250,429	676,834
JACKSONVILLE ELECTRIC COMPANY.					
March, 1911	$51,900	$28,376	$23,524	$10,450	$13,074
March, 1910	52,557	26,973	25,584	9,469	16,115
LOWELL ELECTRIC LIGHT CORPORATION.					
March, 1911	$38,673	$23,330	$15,343	$4,763	$10,580
March, 1910	35,037	19,955	15,082	4,721	10,361
MINNEAPOLIS GENERAL ELECTRIC COMPANY.					
March, 1911	$110,191	$46,191	$64,000	$35,445	$28,555
March, 1910	103,966	41,567	62,399	31,427	30,972
NIAGARA, ST. CATHARINES & TORONTO RAILWAY COMPANY.					
Year, 1910	$338,761	$250,719	$88,042	$79,131	$8,911
Year, 1909	299,941	207,297	92,644	74,897	17,746
NORTHERN TEXAS ELECTRIC COMPANY.					
March, 1911	$142,938	$74,894	$68,044	$25,137	$42,907
March, 1910	128,679	67,290	61,289	18,786	42,603
PACIFIC GAS & ELECTRIC COMPANY.					
Year, 1910	$13,859,964	$7,921,341	$5,938,623	$3,006,156	$2,932,467
Year, 1909	13,332,501	7,531,576	5,800,925	2,988,522	2,812,403
PUGET SOUND ELECTRIC RAILWAY.					
March, 1911	$143,638	$106,383	$37,255	$52,276	$15,021
March, 1910	157,779	125,178	32,601	50,607	*18,006
SAVANNAH ELECTRIC COMPANY.					
March, 1911	$53,062	$34,770	$18,292	$18,282	$10
March, 1910	49,907	32,049	17,858	17,847	11
SEATTLE ELECTRIC COMPANY.					
March, 1911	$458,458	$271,838	$186,620	$115,593	$71,027
March, 1910	461,289	279,053	182,246	110,109	72,137
SOUTHERN POWER COMPANY.					
Year, 1910	$1,263,479	$455,542	$807,937	$200,000	$607,937
Year, 1909	819,290	313,334	505,956	150,000	355,956

*Deficit.

General News

Construction News.

COLUMBIA, ALA.—The installation of an electric-light plant and sewerage system in Columbia is reported to be under consideration.

MONTGOMERY, ALA.—The Montgomery Light & Water Power Company, it is reported, has placed contracts for a 1000-kw turbine and will also install a jet type condenser. The cost of the improvements is estimated at about $25,000.

PHOENIX, ARIZ.—Arrangements are being made by the Phoenix Railway Company for the construction of two extensions, one to Ingleside and Scottsdale, and the other on Central Avenue across the new bridge and through Tempe to Mesa.

SAFFORD, ARIZ.—The Safford Water & Electric Company is constructing a dam and storage reservoir in the mountains near Safford and will bring water to the city for its distributing system by means of a pipe line.

ALAMEDA, CAL.—It is expected that a special election will be held in July to vote on the proposition to issue $175,000 in bonds, of which the proceeds of $100,000 will be used for the erection of a new power house for the municipal electric-light plant and for new equipment for same.

BAKERSFIELD, CAL.—Work will begin at once on the construction of the first of the substations to be erected at different points in this county by the San Joaquin Light & Power Company. The first station will serve Moron and Maricopa, the next will be erected at McKittrick and later one at Famosa.

LOS ANGELES, CAL.—Rights-of-way are being secured by the Glendale & Eagle Rock Railway Company for an electric railway which will connect its lines and the Glassell and Workman ranches. The company will also make extensions on certain streets in Glendale.

SAN BERNARDINO, CAL.—The substation of the San Bernardino Valley Traction Company, located at the mouth of Waterman Canyon on the Arrowhead-Hot Springs branch, was recently destroyed by fire, entailing a loss of about $7,000.

SAN FRANCISCO, CAL.—It is reported that Law Brothers, of San Francisco, Cal., are negotiating for a right-of-way for an electric railway through Marin County.

SAN FRANCISCO, CAL.—It is reported that the executive committee of the Great Western Power Company has authorized an expenditure of $1,000,000 to increase the output of the hydroelectric generating station at Las Plumas, on the Feather River, and to start work on the second development above Las Plumas. The present station of the company has an output of 55,000 hp, which will eventually be doubled.

SAN JOSE, CAL.—Preparations are being made by the United Gas & Electric Company for the erection of a high-tension transmission line from San Jose to Alum Rock Park.

STOCKTON, CAL.—The Tidewater & Southern Railroad Company, which is now constructing an electric railway from Stockton to Modesto, is planning to extend the railway to Merced, a distance of 25 miles. K. C. Brueck, of Stockton, is president.

WILLOWS, CAL.—The Sacramento Valley West Side Electric Railway Company, recently organized, is planning to build an electric railway from Woodland north to Kennett, via Red Bluff, Golusa and Redding. C. L. Donohue, of Willows, and E. L. Sisson are interested in the project.

WASHINGTON, D. C.—Bids will be received by the Department of the Interior, Washington, D. C., until May 18, for the erection and completion of a concrete coal bunker and conveyor machinery for the central heating and lighting plant at the Freedmen's Hospital and Howard University, Washington, D. C., in accordance with specifications and drawings, copies of which may be obtained upon application to the chief clerk of the department. Carmi A. Thompson is assistant secretary.

WASHINGTON, D. C.—Sealed proposals will be received at the office of the Supervising Architect, Treasury Department, Washington, D. C., until June 1, for supplying and installing lighting fixtures in the United States buildings at Amsterdam, N. Y.; Keene, N. H.; Marlboro, Mass.; Woburn, Mass.; Olean, N. Y.; Shamokin, Pa.; Webster, Mass., and Lynchburg, Va., in accordance with drawings and specifications, copies of which may be obtained at the above office. James Knox Taylor is Supervising Architect.

QUINCY, FLA.—The People's Ice, Fuel & Supply Company, of Quincy, Fla., has secured a location in Port St. Joe, on which it proposes to erect an electric light and ice plant. It is understood that contracts have already been placed for machinery for the plant. Robert Sylvester, of Quincy, is president.

SANFORD, FLA.—Preliminary arrangements have been made by the Citrus Southern Electric Railway Company for construction of its proposed electric railway between Kissimee, Sanford and Orlando, 45 miles in length. J. J. Brophy, of Winter Park, is general manager.

WEST PALM BEACH, FLA.—It is reported that the Ariston Ice & Electric Company will apply to the City Council for a new franchise. The company contemplates making extensions to its plant, including the installation of additional machinery involving an expenditure of $15,000.

WEST POINT, GA.—Plans are being considered for the construction of an electric railway to connect West Point, Hamilton, Talbotton, Forsyth and Monticello.

BONNERS FERRY, IDAHO.—Plans are being considered by the Bonner Water & Light Company for improvements and extensions to its plant. A. H. Featherstone is owner.

CALDWELL, IDAHO.—The City Council is reported to be considering the installation of an electric-lighting system in Caldwell.

ABINGDON, ILL.—The Mutual Union Telephone Company has filed an amendment to its charter increasing its capital stock from $15,000 to $40,000.

BRYON, ILL.—It is reported that surveys are being made for the construction of a large dam and hydroelectric plant in Byron.

CHICAGO, ILL.—It is reported that plans have been completed for the consolidation of the North Shore Electric Company, operating in thirty-two communities north and west of the city, the Economy Light & Power Company, operating in twenty or more towns in Desplaines River Valley, and the Illinois Valley Gas & Electric Company, with plants already in operation and under construction in twenty-eight villages and cities throughout the Illinois valley. The combined capital stock of the three companies amounts to $11,564,000 and funded indebtedness to $9,751,000. Samuel Insull, president of the Commonwealth Edison Company, is president of both the North Shore Electric Company and the Economy Light & Power Company, and also a director of the Illinois Valley Gas & Electric Company.

EAST ST. LOUIS, ILL.—The East St. Louis Interurban Electric Company, recently incorporated, proposes to construct an electric railway from the city of East St. Louis, Clair County, Ill., in an easterly direction to a point in Clinton County, Ill. J. L. Flannigan, W. H. Hauss and Edward L. Cragon, all of East St. Louis, Ill., are among the directors.

FT. SHERIDAN, ILL.—Bids wil be received at the office of the Constructing Quartermaster, Ft. Sheridan, Ill., until June 5 for furnishing and installing a sewage disposal plant, complete, including hydrolitic tank, filters, sludge beds, pumps, motors, electric pole line and connections, sewer main and outlet, etc., at Ft. Sheridan. Bids for the work complete only will be considered. A limited number of plans will be supplied from this office upon deposit of $25, which will be refunded upon return of same. Plans and specifications may be seen at this office and at the office of the Chief Quartermaster, Department of the Lakes, Federal Building, Chicago, Ill.; office of the Depot Quartermaster, Army Building, Whitehall Building, New York, N. Y. Captain M. E. Saville is constructing quartermaster.

GIBSON CITY, ILL.—The City Council has granted A. Hood, of Chicago, Ill., a thirty-year franchise to construct and operate an electric light plant in Gibson City. The franchise provides that iron poles shall be used within the fire limits, the installation of an alternating-current system, meters to be furnished to all consumers free of charge, electricity for lighting the city hall and water-works plant to be furnished free of charge; also to light the streets of the city at reduced rates and a reduction in the price of electricity for commercial purposes. Mr. Hood agrees to install a $50,000 plant and have it in operation by Sept. 1, 1911.

OLNEY, ILL.—The local electric light plant, owned by Arthur Schultz, is reported to have been purchased by H. H. Knipe, of Robinson, Ill., president of the Southeastern Illinois Long Distance Telephone & Telegraph Company.

WASHBURN, ILL.—F. E. Downing, of Decatur, Ill., is reported to have taken over the local electric light plant owned by Messrs. Moll & Shride, of Decatur, Ill.

ANGOLIA, IND.—F. S. Hunting has been appointed receiver for the Angolia Railway & Power Company. The company operates the street-car system, supplies electrical service in the city, furnishes power to operate the pumping station of the city water-works and operates a short traction line between Angolia and Lake James. It is said that there is a mortgage of $100,000 outstanding against the company. The property of the company is valued at $75,000.

BRAZIL, IND.—Specifications prepared by Frank Kaltman, city engineer, for lighting the streets and public buildings for a term of ten years have been approved by the City Council. Bids will soon be called for and if the bids submitted are not satisfactory a municipal electric plant will be installed as planned. The present contract expires April 1, 1912.

CRAWFORDSVILLE, IND.—The City Council has voted to install

ornamental cluster lamps on the principal streets of the city. The lamps will be erected on stone lamp standards, costing $30 each. The style of lamp has not yet been decided upon.

INDIANAPOLIS, IND.—The Monon Railroad Company has submitted plans to the Railroad Commission for the installation of electric automatic block signals between Indianapolis and Chicago.

KENTLAND, IND.—The City Council is asking for funds for a franchise for lighting the streets and public buildings for a term of twenty years.

MIDDLETOWN, IND.—Injunction proceedings have been brought to prohibit the Town Trustees from entering into a contract with the Indiana Union Traction Company to furnish electricity to light the city. The citizens voted almost unanimously to install a municipal electric light plant and the money is in the treasury. Later the board decided it would be cheaper to secure the service from the traction company. The citizens are insisting on the installation of a municipal plant.

PRINCETON, IND.—The City Council has ordered all poles and wires removed from the business portion of the city and placed underground. The present arc lamps will be replaced by a system of ornamental cluster lamps.

RICHMOND, IND.—The Richmond & Cincinnati Traction Company has applied for a charter in Indiana for the purpose of constructing an electric railway to connect Richmond, Ind., and Cincinnati, Ohio, which later will be extended to Union City. The company is capitalized at $50,000.

TERRE HAUTE, IND.—The City Council has approved the contract entered into by the Board of Public Works with the Terre Haute, Indianapolis & Eastern Traction Company for lighting the streets and public buildings. The contract is for a period of ten years, under which the company is to furnish arc lamps at the rate of $67 each per year.

YORKTOWN, IND.—Marion Sears, of Yorktown, Ind., is reported to be organizing an electric light company for the purpose of supplying electricity in the towns of Yorktown, Daleville and Chesterfield and to the farmers along the transmission line between the towns. Mr. Sears has made arrangements to secure electricity to operate the proposed system from the plant of the Muncie Electric Light Company, of Muncie, Ind.

ANAMOSA, IA.—It is reported that bids will soon be asked by the Board of County Commissioners of Jones County for the installation of an electric-light plant for the county home building, now under construction. Louis Gardner is county auditor.

DES MOINES, IA.—The Fort Dodge, Des Moines & Southern Railway Company, it is reported, is contemplating equipping its system within the city limits for electrical operation.

DUBUQUE, IA.—The question of installing an ornamental street lighting system in the business district is reported to be under consideration.

DUBUQUE, IA.—It is reported that the La Crosse Telephone Company has secured a site in Dubuque on which it will erect a telephone exchange building, to cost about $15,000.

MONTICELLO, IA.—Fred J. Cross, of Monticello, Ia., has been granted franchises to operate electric lighting systems in the cities of Center Point, Walker, Coggon, Central City. Propositions have also been submitted to other towns in Linn County. It is reported that it is proposed to erect a plant in Central City and supply the service in all the towns from one central plant.

OTTUMWA, IA.—The business men are contemplating the installation of an ornamental lighting system in the business district, covering twenty blocks.

COLDWATER, KAN.—The contract for the construction of the proposed municipal electric-light plant and water-works system is reported to have been awarded to Fred M. Clark, of Savannah, Mo., for $29,180. Plans were prepared by the J. S. Worley Company, Reliance Building, Kansas City, Mo.

FORT SCOTT, KAN.—The plant of the Fort Scott Gas & Electric Company is reported to have been destroyed by fire recently, causing a loss of about $150,000.

WICHITA, KAN.—Sealed bids will be received at the office of the Supervising Architect, Treasury Department, Washington, D. C., until May 29 for furnishing and installing an electric passenger elevator, etc., in United States post office and court house at Wichita, Kan., in accordance with drawings and specifications, copies of which may be obtained at the above office. James Knox Taylor is Supervising Architect.

DRY RIDGE, KY.—The citizens of Independence have raised $50,000, the amount necessary to secure the extension of the Cincinnati, Louisville, Lexington & Maysville Traction Company's system through Independence. W. T. S. Blackburn, of Dry Ridge, is president of the company.

LEXINGTON, KY.—Preparations are being made by the Lexington & Interurban Railways Company for the construction of an extension from Lexington to Nicholasville, 22 miles in length.

LEXINGTON, KY.—The Kentucky Traction Company, the Lexington Railway Company, the Bluegrass Traction Company and the Lexington Utilities Company have been consolidated under the name of the Kentucky Traction & Terminal Company. The merger will become effective May 17. The new company will control the Stout railway system of Lexington and all interurban railways running out of Lexington to the surrounding Bluegrass towns.

LIBERTY, KY.—The installation of an electric-light plant in Liberty is reported to be under consideration. Messrs. Herren & Cundiff are said to be interested in the project.

NORTONVILLE, KY.—The Nortonville Traction Company will soon begin work on the construction of its electric railway in Nortonville. The power station will be located in Nortonville and will supply electricity for lamps. The company is capitalized at $100,000. The officers are: Frank E. Mohr, of Nortonville, Ky., president; T. F. Callard, vice-president, and Frank G. Hoge, secretary and treasurer.

SHREVEPORT, LA.—The City Council has engaged Anderson Offutt, of New Orleans, La., electrical engineer, to make investigations and estimates of cost of constructing a municipal electric-light plant in Shreveport.

BURLINGTON, MASS.—The Edison Electric Illuminating Company of Boston, Mass., has secured a franchise to supply electricity in the town of Burlington for both street and commercial lighting. Post office address is Woburn.

GARDNER, MASS.—Contracts have been closed by the Connecticut River Power & Transmission Company, through its subsidiary, the Gardner Electric Light Company, with the towns of Westminster, Hubbardstown and Barre, to furnish electricity for lighting the streets and for domestic and industrial purposes. Walter A. Belcher, of Gardner, Mass., superintendent, will have charge of the installation of the several systems.

HOLYOKE, MASS.—The Deane Steam Pump Company is contemplating the installation of a new power plant and expects to be in the market for equipment for a power plant having an output of about 450 kw. Oil, gas and steam plants will be considered. Charles L. Newcomb is general manager.

MILLER'S FALLS, MASS.—The Miller's River Street Railway Company will soon apply for a charter in Massachusetts to construct and operate an electric railway to connect Miller's Falls, Montague, Erving, Wendall and Orange. The capital stock of the company is placed at $70,000. Daniel P. Abercrombie, Jr., of Montague; Charles W. Clapp, of Greenfield; Marcus A. Coolidge, of Fitchburg, and others are interested in the company.

NORTH ATTLEBORO, MASS.—At a special town meeting held recently the citizens voted to extend the municipal lighting system to the Holmes neighborhood, a distance of 4½ miles.

SPRINGFIELD, MASS.—The contract for installing the electrical equipment in the new group power station and heating plant now under construction has been awarded to the M. B. Foster Company, of Boston, Mass., for $10,500.

STERLING, MASS.—The Selectmen have made arrangements with the Connecticut River Power & Transmission Company to supply electricity in Sterling. The service will be furnished from the substation in Clinton, 2½ miles distant. It is proposed to erect a transformer station in Sterling to reduce the current from 13,000 to 2300 volts. The town hall, two engine houses and library will be lighted by electricity and 80 street lamps installed.

WEBSTER, MASS.—Arrangements are being made by the Webster & Southbridge Gas & Electric Company to extend its transmission lines from Webster to Gore, a distance of 2 miles.

ANN ARBOR, MICH.—A special appropriation of $280,000 has been made by the State Legislature for the purpose of erecting a new heating, lighting and power plant at the University of Michigan.

SEBEWAING, MICH.—The question of installing a municipal electric light plant in Sebewaing is under consideration.

THREE RIVERS, MICH.—At an election held recently the citizens voted in favor of the proposition to purchase the Emery water power at a cost of $40,000.

DELANO, MINN.—The Oscar Claussen Engineering Company, of St. Paul, Minn., has been engaged to prepare a preliminary report for remodeling the present municipal electric plant or construction of a new plant to provide the village of Delano with a 24-hour service. When plans are prepared the proposition to issue bonds to secure funds for improvements will be submitted to a vote of the people.

MANKATO, MINN.—Bids will be received by D. Donohue, village clerk, North Mankato, Minn., until May 22 for the construction of water works, consisting of two three-phase, 60-cycle, 220-volt motors direct-connected to pumps. Bids will be received on electric pumping equipment; single-stage centrifugal pumps; alternate bids on gasoline equipment, consisting of engine and triplex pump, will be considered. Separate proposals will be received on reservoirs, pump house, pumping equipment, water mains and well. Plans may be seen at the office of the village clerk or at the office of John Wilson, engineer, Mankato, Minn.

MINNEAPOLIS, MINN.—Dr. P. M. Hall, health commissioner, is reported to be preparing plans for enlarging the municipal incinerating plant and installing additional electric generators so as to enable the plant to supply electricity for lamps for workhouse, Hopewell Hospital and 20 miles of streets in vicinity of workhouse.

PROCTOR, MINN.—Plans are being made by the Duluth Telephone Company for improvements to its local system, involving an expenditure of about $25,000.

WINONA, MINN.—The Wisconsin-Minnesota Power Company has applied to the City Council for a franchise to enter this city. It is said that the new company is contemplating taking over the local electric company.

COLUMBIA, MO.—Bids will be received by John S. Bicknell, city clerk, until May 16 for the construction of an electric light and power plant. Plans can be obtained from H. H. Humphrey, Chemical Building, St. Louis, Mo., engineer, or may be seen at the office of the city clerk.

ST. JOSEPH, MO.—The St. Joseph Railway, Light, Heat & Power Company has announced a reduction of 15 per cent. in rates for electricity for lamps for commercial and residential lighting to take effect from May 1.

ST JOSEPH, MO.—The City Council has authorized City Counselor Norris to take preliminary steps looking to the submission of the proposition to issue bonds for extensions and improvements to the municipal electric light plant for the purpose of supplying electricity for commercial lighting.

HELENA, MONT.—Plans are being considered by the Helena Light & Power Company to double-track its electric railway to the State fair grounds, for which, it is said, bonds to the amount of $100,000 will be issued. J. G. White & Company, 49 Exchange Place, New York, N. Y., are general managers.

VIRGINIA CITY, MONT.—Surveys have been completed and rights of way secured for an electric railway between Alder and Virginia City. L. H. Leber and R. J. Watson are interested in the project.

ANSELMO, NEB.—The establishment of a municipal electric-light plant and water-works system in Anselmo is reported to be under consideration.

NIOBRARA, NEB.—Preparations are being made by the Sioux City Service Company, of Sioux City, Ia., for developing that water-power of the Niobrara River. About 10,000 hp will be developed at a cost of $1,500,000.

OMAHA, NEB.—The Omaha & Council Bluffs Street Railway Company has awarded the contract for the construction of a substation at Fifth and Jones Streets to B. J. Jobst. The building will be 60 ft. x 40 ft., one story high, and will cost about $100,000.

PORTSMOUTH, N. H.—The contract for extensions to the heating and power plant at the navy yard at Portsmouth, N. H., has been awarded to the Walworth Manufacturing Company, of Boston, Mass., for $36,560.

PASSAIC, N. J.—Bids will be received by the city of Paterson until May 19 for furnishing and installing a police signaling system, fire-alarm equipment and municipal telephone exchange for the city of Passaic, in accordance with specifications and drawings on file in the office of the city clerk. Thomas R. Watson is city clerk.

RED BANK, N. J.—The Shore Lighting Company, which is a consolidation of the Shore Electric Company, of Red Bank, N. J.; the Seabright Electric Light Company, of Seabright, N. J., and the Citizens' Light & Fuel Company, of South Amboy, N. J., has been taken over by the Public Service Corporation of New Jersey. The electric-lighting business has been turned over to the Public Service Electric Company and the gas business to the Public Service Gas Company. The deal has been approved by the Board of Public Utility Commissioners.

TUCUMCARI, N. M.—It is reported that improvements and extensions will be made to the local electric light plant.

ALBANY, N. Y.—Bids will be received by the Board of Contract and Supply, Albany, N. Y., until May 15 for the installation of a police signal system in the First, Second, Third and Fifth precincts and the equipment of the boxes now in use in the Fourth precinct with lights, etc., to conform with the system to be installed in the other four precincts. Forms of proposals and specifications and form of contract can be seen at the office of the Board of Contract and Supply, City Hall, Albany, N. Y. Isidore Wachsman is secretary of board.

GLOVERSVILLE, N. Y.—The city of Gloversville, it is reported, is contemplating the installation of a municipal electric-light plant.

LITTLE FALLS, N. Y.—Surveys are being made by the Little Falls & Johnstown Railroad Company for its proposed railway between Little Falls and Johnstown, via St. Johnsville.

NEW YORK, N. Y.—The contract for furnishing materials and electric wiring and appurtenances for light and power for the Metropolitan Hospital and surrounding buildings, Blackwell's Island, City of New York, has been awarded to the New York Construction Company, 1328 Broadway, New York, N. Y., for $19,740. J. McKee Borden is secretary.

ROCKVILLE CENTRE, N. Y.—At a special election held recently the citizens voted to appropriate $17,000 for the construction of a new power house equipped with two 800-hp boilers. Provisions will be made for the installation of two additional boilers when necessary. The new equipment will also include a coal hoist operated by a motor.

SYRACUSE, N. Y.—The Syracuse, Watertown & St. Lawrence River Railroad Company, recently incorporated, is planning to build an electric railway to connect Syracuse, Watertown, Cicero and Brewerton. The proposed railway will be 7 miles long and will connect with the Syracuse & South Bay Electric Railroad in Cicero and extended to Brewerton. The company is capitalized at $1,250,000, and the incorporators are: J. S. Moore, W. W. Foster and M. H. Knapp.

BURLINGTON, N. C.—The Piedmont Railway & Electric Company, recently incorporated with a capital stock of $1,000,000 is planning to construct electric railways to connect Burlington, Haw River and Graham with the local railways. The charter of the company gives it the privilege of supplying electricity for lamps and motors. E. S. Parker, J. M. Cook and A. L. Davis are interested in the company.

CHARLOTTE, N. C.—The Southern Power Company, of Charlotte, N. C., has awarded a contract to the Westinghouse Electric & Manufacturing Company, of Pittsburgh, Pa., for furnishing electrical equipment for the interurban electric railway extending from Charlotte to Kings Mountain, 32 miles in length, to cost $300,000. The equipment includes eight locomotives of the motor type, transformers, equipment for cars, etc.

HENDERSON, N. C.—The plant and holdings of the Henderson Lighting & Power Company have been taken over by the North State Hydro-Electric Company, of Raleigh, N. C.

HENDERSONVILLE, N. C.—Plans are being made by C. F. White to organize a company to build an electric railway from the depot in Hendersonville to Osceola Lake, via Columbia Park, 2 miles in length, for which about $10,000 has been subscribed. It is expected to extend the line in the near future, making a belt line through that vicinity.

KALEIGH, N. C.—The Carolina Power & Light Company has purchased the plant and holdings of the Standard Gas & Electric Company, of Raleigh. The Carolina company is now completing the large hydro-electrical development at Blewett's Falls.

RUTHERFORD, N. C.—The North Carolina Interurban Railroad Company has filed notice that it is ready to proceed with the construction of its proposed electric railway, which is to connect Asheville and Gastonia. The proposed railway will be about 92 miles in length.

SALISBURY, N. C.—The W. J. Oliver Company, recently incorporated with a capital stock of $400,000, for the purpose of taking over the Salisbury-Spencer Street Railway & Electric Company, is preparing to extend its railway to nearby towns. The company has a franchise for an electric railway from Salisbury to Concord, a distance of 22 miles. W. J. Oliver, of Knoxville, Tenn.; John M. Beall, of St. Louis, Mo.; T. J. Jerome, of Salisbury, N. C., are interested in the company.

WILMINGTON, N. C.—The Tidewater Power Company, it is reported, is contemplating increasing the output of its power house and will install additional machinery, including a 400-hp boiler, improvements to gas plants, etc.

CANTON, OHIO.—Arrangements are being made by the Canton Electric Company for extensions to its property, which will involve an expenditure of $300,000 this year. The present plans of the company provide for an expenditure of $1,500,000 in Canton during the next five years. Work will soon begin on the construction of an addition to the power plant to cost $50,000. The equipment to be purchased will include one 2000-kw and two 4000-kw generators. W. C. Anderson is manager.

CLEVELAND, OHIO.—It is reported that the Euclid Doan Power Company, of Cleveland, Ohio, recently incorporated, is planning to erect a power plant to generate electricity for commercial purposes. S. H. Selbert, Joseph Morgenstern, F. Ethel Whipp, Sidney S. Harvey and A. J. Harvey are the incorporators.

CLEVELAND, OHIO.—It is reported that plans are being made to organize a company to build an electric railway between the southern limits of the city of Cleveland and the race track at Randall, a distance of 7 miles. It is expected that the Cleveland Railway Company will be asked to supply electricity for operating the proposed railway.

CLEVELAND, OHIO.—The Hardin-Wyandotte Lighting Company has filed a mortgage at Upper Sandusky in favor of the Cleveland Savings & Trust Company to secure an issue in bonds. The company has absorbed the electric light plants in Kenton, Dunkirk, Forest and Upper Sandusky, and will supply electrical service to all the above towns from its plant in Kenton. Donald McBride is president and F. S. Whitcomb is secretary, both of Cleveland, Ohio.

DAYTON, OHIO.—Bids will be received by the Board of Trustees of the Dayton State Hospital, Dayton, Ohio, until May 23 for furnishing and installing a 250-kw direct-current generator direct-connected to a slow-speed Corliss engine, and for making certain switchboard changes. Specifications may be secured from A. F. Shepherd, M. D., superintendent Dayton State Hospital.

FOSTORIA, OHIO.—Arrangements are being made by the Fostoria & Fremont Electric Railway Company for the construction of an electric railway between Fremont and Port Clinton, 18 miles in length. J. D. McClinton is secretary of the company.

GREENSPRING, OHIO.—The Village Council is considering the installation of an electric-light plant in Greenspring.

MIDDLETOWN, OHIO.—Notice has been filed with the Secretary of State of the consolidation of the Middletown Gas & Electric Company and the Middletown Lighting Company under the name of the Middletown Gas & Electric Company, with a capital stock of $350,000.

OBERLIN, OHIO.—Attorney Hart, of Cleveland, Ohio, has been appointed receiver of the Oberlin Gas & Electric Company. The company supplies heat, light and power throughout the city and also furnishes electrical service and steam heat to Oberlin College.

MUSKOGEE, OKLA.—It is reported that preliminary surveys are being made for a water-power site on the Illinois River in the Cherokee Nation, about 15 miles above the confluence of the Illinois

and Arkansas Rivers. The proposed site is situated about half way between Tahlequah and Gore. The present plans call for the construction of a large dam and hydroelectric power plant to supply electricity to operate the proposed new interurban electric railway which Ex-Governor Haskell is building between Muskogee and Fort Gibson. It is said if power can be secured in the Illinois River, the electric railway will be extended from Fort Gibson to Fort Smith.

OKLAHOMA CITY, OKLA.—The Oklahoma Gas & Electric Company is contemplating extending its system to Britton, to the new college for girls, 1½ miles north of Britton; also east to the State Fair Grounds and to other sections of the city. The cost of the extension to Britton is estimated at about $20,000. The company also contemplates extending its transmission lines to the outlying districts suitable for manufacturing and industrial purposes, if sufficient business is guaranteed to pay for the extension. Extensions to the lighting system will also be made in Linwood, Miller and Classen Boulevard additions, to the State Fair Grounds amusement park, on West Main Street and on West Sixteenth Street.

SKIATOOK, OKLA.—It is reported that the citizens have voted to issue bonds for the installation of an electric-light plant in Skiatook.

WAYNOKA, OKLA.—William Haviland, of Alva, Okla., is reported to be preparing plans for the construction of the proposed electric-light plant and water-works system, for which bonds to the amount of $27,000 have been voted. C. D. Willard is town clerk.

WELEETKA, OKLA.—At an election held recently the citizens voted to issue bonds to the amount of $45,000, the proceeds to be used for the installation of an electric-light plant and water-works system.

PORTLAND, ORE.—It is reported that plans are being prepared by the Oregon-Washington Railroad & Navigation Company for the construction of a telephone system to connect all the general offices in Seattle, Tacoma, Wash., and Portland, Ore., on a single exchange. The cost of the proposed system is estimated at about $70,000.

VALE, ORE.—The Malheur Independent Telephone Company, recently incorporated with a capital stock of $15,000, proposes to obtain control of all of the telephone lines in the county and extend its lines in all directions. The company is now erecting a line from Vale to Watson, a distance of about 50 miles.

OIL CITY, PA.—Bids will be received by the city of Oil City, Pa., until May 19 for replacing the present Gamewell fire-alarm telegraph system, having a two-circuit gravity battery, with a four-circuit storage battery with switchboard complete. Bidders must furnish plans and specification of proposed battery and switchboard. C. W. Mullalley is city controller.

PITTSBURGH, PA.—Preparations are being made by Dilworth, Porter & Company to enlarge their mill, which will be equipped for electric-motor drive. A contract for electrical equipment has been awarded to the General Electric Company, of Schenectady, N. Y.

TYRONE, PA.—The Mountain City Light, Heat & Power Company, now operating a power plant at Tyrone, and owning water rights extending from Huntingdon Township, Huntingdon County, to west of the boundary of Logan Township, Blair County, has been granted a charter. The new charter gives the company water rights in Huntingdon County and Logan Township.

WOODLAWN, PA.—The Woodlawn & Southern Street Railway Company has awarded the contract for the construction of its proposed electric railway from Woodlawn to Aliquippa, with a branch on Franklin Avenue to Woodlawn, extending to New Sheffield, to J. G. McGuire & Company, of New Brighton, Pa. J. I. Moore is interested in the company.

EDGEFIELD, S. C.—The City Council has called an election to be held June 18 to vote on the proposition to issue bonds to an amount not exceeding $15,000, the proceeds to be used for installing an electric-light plant in Edgefield.

GREENVILLE, S. C.—The Greenville, Spartanburg & Anderson Railway Company has applied to the Secretary of State for permission to increase its capital stock from $300,000 to $4,000,000, and to construct an electric railway from Belton to Greenwood.

CUSTER, S. D.—The City Council has granted the Custer Electric Light, Heat & Power Company a fifty-year franchise to supply electricity for lamps and motors in Custer. The company has acquired the property of the paint factory, located on French Creek, within the town limits. Contracts have been awarded for rebuilding the building, and it is expected that contracts for electric apparatus will soon be awarded. E. L. Grantham is president and H. E. Hay secretary.

PIERRE, S. D.—The Sioux Falls & Southern Minnesota Traction Company has applied for a charter in South Dakota for the purpose of constructing an electric railway from Sioux Falls, S. D., to Albert Lea, Minn., via Worthington, Sheppard, Spring Valley, Dresden, Loon Lake, Petersburg, Ceylon, Silver Lake, East Chain and Pilot Grove, Minn. The capital stock of the company is placed at $300,000. The incorporators are: L. B. Wyckoff, of Syracuse, N. Y.; J. J. Davenport, H. W. Knight and Charles S. Sollas, of Chicago, Ill., and G. P. Peterson, of Pierre, S. D.

CUMBERLAND GAP, TENN.—Negotiations are under way between this city and Middleborough, Ky., whereby the latter will supply electricity for lamps in Cumberland Gap. Preparations are being made to develop the water power of Gap Creek for power purposes. A large dam is being built which when completed will supply power for several large manufacturing plants.

AUSTIN, TEX.—Plans are being considered by W. D. Shelly, of Austin, and associates, for the construction of an electric railway in the western portion of the city. The proposed railway will be about two miles in length and will reach the business portion of the city.

AUSTIN, TEX.—The J. T. Cogan Company, of New York, N. Y., has submitted a proposition to the City Council to rebuild the dam across the Colorado River and install a hydroelectric plant in Austin. The plans includes replacing the dam and hydroelectric plant at a cost of $1,000,000, which is to be paid by the city at the rate of $50,000 per annum from the earnings of the water-works and electric light and power departments. An election will be called in the near future to submit the proposition to a vote of the people.

BRYAN, TEX.—The City Council has purchased the plant and holdings of the Bryan Water, Ice, Light & Power Company, to be owned and operated by the municipality. Improvements and extensions will be made to the plant.

FLORESVILLE, TEX.—The installation of an electric light plant in Floresville is reported to be under consideration. A. B. Crawford, of San Antonio, is said to be interested in the project.

GAINESVILLE, TEX.—Plans are being considered by M. A. Hindman, of Fort Worth, Tex., and associates for the construction of an electric railway to connect Gainesville, Tioga and McKinney. The construction of an electric railway from Gainesville to Sherman, via Whitesboro, is also under consideration.

GRANBURY, TEX.—The Granbury Water, Ice, Light & Power Company is reported to be in the market for a 100-hp gas producer and engine. James W. Hackaday is manager.

HOUSTON, TEX.—The trustees of the Rice Institute are reported to have awarded the contract for the equipment of power plant to the Walworth-English-Flett Company, of Boston, Mass., for $156,950.

TEXAS CITY, TEX.—The Texas City Transportation Company has made arrangements for the installation of an electric telpher system in its warehouses devoted to the New York business. If the system proves satisfactory, all of the warehouses will be equipped with it. The company will also equip its piers with electric cranes to handle freight. Plans are also being made by the company to install shops, which will be equipped for electric motor drive.

OGDEN, UTAH.—The City Council has granted the Oregon Short Line Railroad Company a franchise to build a spur track on Twentieth Street and Wall Avenue.

OGDEN, UTAH.—The City Council has awarded the contract for street lighting to the Merchants' Light & Power Company, recently organized by local business men in Ogden. Under the terms of the contract the company is to supply arc lamps at the rate of $4.75 each per month. The Utah Light & Railway Company submmitted a bid offering to supply street lamps at the rate of $5 per lamp per month. Under the present contract the city pays $6 per lamp per month. The Merchants' Light & Power Company must have its plant in operation within 120 days. Work has not commenced on the proposed plant.

BRATTLEBORO, VT.—The question of providing ornamental lamp standards on Main and Elliot Streets will be submitted to a vote at a town meeting to be held soon. It is estimated that about 50 standards will be required.

BURLINGTON, VT.—The Burlington Light & Power Company has submitted a proposition to the city offering to supply electricity for municipal and for commercial lighting, during the pendency of the injunction proceedings now in court, at less cost than the city can generate the same at the municipal plant.

BARNETT, VA.—Preparations are being made by the residents of West Barnett and farmers along the proposed line to form a company under the name of the Barnett Center Electric Light & Power Company for the purpose of supplying electricity in West Barnett and to the farmers along the route of the proposed transmission line. Arrangements have been made with D. L. Judkins, owner of the local electric plant, to supply electricity for the system. About $5,000 has been raised toward the project. L. H. Thornton has been elected temporary president; Wilbur Wilson, M. A. Roy, J. L. Allen, C. S. Carter and H. J. Brock are interested in the enterprise.

FALLS CHURCH, VA.—The Arlington Electric Company, recently organized, has made arrangements with the Falls Church Telephone Company to use its poles to carry its wires. The company proposes to supply electricity through Alexandria County, and will purchase electrical energy to operate its system from the Washington-Virginia Electric Railway Company.

NORFOLK, VA.—The Norfolk Railway & Light Company is reported to be contemplating extending its railway to Richmond and Washington.

ROCKY MOUNT, VA.—At an election to be held June 14 the proposition to issue $50,000 in bonds, the proceeds to be used to establish an electric-light plant and water-works system, was carried.

GOLDENDALE, WASH.—The local electric light plant, owned by H. W. Fellows, has been purchased by the Pacific States Electric Company, of Portland, Ore. The consideration is understood to be about $55,000. The new owners, it is said, will extend and improve the system.

KALAMA, WASH.—The Washington-Oregon Corporation is reported to be contemplating the construction of a 12,000-hp plant at the old site on the Kalama River.

MARCUS, WASH.—The City Council has accepted the proposition submitted by H. V. Gates, of Hillsboro, Ore., to supply the town with electricity and water. The franchise calls for the installation of a high-pressure gravity water system. Electricity will be supplied from the power plant, located near Meyers Falls. The cost of installing the two systems is estimated at $40,000.

MONTESANO, WASH.—At an election held recently the proposition to issue $125,000 in bonds, the proceeds to be used to purchase the plants of the Montesano Light & Water Company, was defeated.

PASCO, WASH.—The City Council is reported to have engaged E. Tappan Tannatt, State Building, Spokane, Wash., consulting engineer, to make an appraisal of the plant and holdings of the Pacific Power & Light Company, which the city proposes to purchase, to be owned and operated by the municipality.

SEATTLE, WASH.—The County Commissioners are reported to have engaged J. H. Hull to prepare plans and specifications for additions to the lighting and power plant at the Kings County Hospital.

SEATTLE, WASH.—A bill has been passed authorizing an expenditure of $75,000 for the construction of a new power plant to be used in connection with the municipal power plant on Cedar River. The proposed plant will be located on Lake Union at the foot of Nelson Place and will have an output of about 2000 hp. It is expected that plans and specifications will be prepared at once. The present plans call for laying a steel main from the Volunteer Park reservoir to the new plant.

SISTERSVILLE, W. VA.—Bids will be received at the office of the city clerk of Sisterville, W. Va., until May 15 for construction of power house for the municipal water-works system, plans and specifications for which are on file at the office of W. J. Alexander, architect, New Martinsville, W. Va., and at the office of the water commissioner, Sisterville, W. Va.

ARCADIA, WIS.—Vaughn & Meyer, of Milwaukee, Wis., have been engaged to prepare plans for the reconstruction of the municipal electric light plant in Arcadia.

CHATHAM, ONT., CAN.—The Chatham, Wallaceburg & Lake Erie Railway Company is planning to build extensions to Blenheim and Sarnia. Work on the Blenheim extension will begin this summer.

COBALT, ONT., CAN.—The McArthur-Forest Company, which controls the Scottish-Ontario mine at Porcupine, is reported to have secured rights for the construction of a power dam across the Mattagami River at Sturgeon Falls, between the Transcontinental Railroad and Porcupine. The water power will be developed to generate electricity which will be transmitted to Porcupine.

GALT, ONT., CAN.—The rates for electricity in Galt supplied from the system of the Toronto Hydroelectric Power Commission have been announced by the fire and light committee. The cost will be computed on a dual basis of area lighted and electricity consumed. The rate is 4 cents per 100 sq. ft. per month plus 4 cents per kw-hour, with a discount of 10 per cent for prompt payment. The new rates will go into effect June 1 and it is estimated that a saving of about 50 per cent will be effected. A by-law to appropriate $25,000 for extensions to the system will be submitted to the ratepayers on May 26.

GUELPH, ONT., CAN.—The Toronto Hydroelectric Power Commission has informed the city of Guelph, Ont., that electricity supplied by the commission to the city of Guelph would cost $25 per hp per year until December, 1912, after which time it would be reduced gradually until it reaches $20 per hp per annum.

New Industrial Companies.

THE BADT-WESTBURG ELECTRIC COMPANY, of Chicago, Ill., has been chartered, with a capital stock of $2,400, by Francis B. Badt, Paul A. Westburg and Fred M. Rosseland. The company proposes to manufacture and deal in electrical instruments and supplies.

THE BOGARDUS COMPANY, of Chicago, Ill., has been incorporated, with a capital stock of $50,000, to manufacture valves, steam gages and engines. The incorporators are: W. L. Barnum, Jr., T. A. Nelson and DeF. M. Neice, of Chicago, Ill.

THE DETROIT AUTOMATIC TELEPHONE COMPANY has been incorporated for the purpose of manufacturing a primary current, direct connection telephone invented by Dr. Leopold F. Mueller. The instrument is so constructed that it will connect an individual with any one or more of a thousand stations by pressing a button. The factory will be located in Detroit, Wyandotte or Adrian, Mich. Dr. Mueller, Charles F. Chisholm and Otto Van Humerich are the incorporators.

THE ECONOMIC RECTIFIER & ELECTRIC COMPANY, of Chicago, Ill., has been incorporated with a capital stock of $25,000 by Arthur C. Ide, Maurice Weigle and Albert L. Letterman.

THE ELECTRICAL PRODUCTS COMPANY, of Saginaw, Mich., has been organized to manufacture an interior telephone designed by John J. Speed, formerly manager of the Valley Home Telephone Company. The new instrument will be called the Speed-I-Phone. The offices of the company are located at 1914-16 South Michigan Avenue, Saginaw, Mich.

THE C. A. FISCHER COMPANY, of West Hoboken, N. J., has been chartered by C. A. Fischer, W. Wollenschlager and C. Struppman, of West Hoboken, N. J. The company is capitalized at $50,000 and proposes to manufacture electrical appliances, etc.

THE GANAHAL ELECTRIC COMPANY, of St. Louis, Mo., has been incorporated by Octavia L. Ganahal, Hubert J. Ganahal and Eric A. Kurgar. The company is capitalized at $2,000 and proposes to do a general electrical contracting and supply business.

THE GERVAIS ELECTRIC MANUFACTURING COMPANY, of Hartford, Conn., has been incorporated by M. I. Smith, E. Raymond Low and Robert W. Smith, of Hartford. The company is capitalized at $50,000 and proposes to manufacture electrical specialties.

THE HIXON ELECTRIC COMPANY, of Boston, Mass., has filed articles of incorporation, with a capital stock of $30,000, for the purpose of manufacturing electrical goods. The directors are: Alfred J. Hixon, 246 Summer Street, Boston, Mass.; C. J. Titus and N. L. Penneck.

THE HOBERT ELECTRIC MANUFACTURING COMPANY, of Troy, Ohio, has been granted a charter, with a capital stock of $20,000, by the Secretary of State, to do business in the State of Illinois.

THE KERITE INSULATED WIRE & CABLE COMPANY, of New York, N. Y., has been granted a charter, with a capital stock of $25,000, to do business in the State of Illinois. The company is a New York corporation and is capitalized at $500,000.

THE RICHMOND LAMP MANUFACTURING COMPANY, of Richmond, Ind., has been incorporated, with a capital stock of $50,000. The company proposes to manufacture carriage, automobile and other lamps. The incorporators are John M. Judson, John C. Ingram and T. W. Judson.

THE SACHS LABORATORIES, Inc., of Hartford, Conn., has been chartered with a capital stock of $50,000 by Joseph Sachs, B. M. W. Hanson, Charles W. Rice and F. C. Nichols, of Hartford, Conn., and C. F. L. Robison, of New Haven. The company proposes to manufacture electrical specialties, etc.

THE SNYDER ELECTRIC COMPANY, of Alexandria, Va., has been chartered with a capital stock of $15,000 to deal in electrical supplies. The officers are: J. Newman Perry, president, and J. A. Sterrett, secretary and treasurer, both of Washington, D. C.

THE SOUTHERN ELECTRIC COMPANY, of Altus, Okla., has been granted a charter, with a capital stock of $10,000, for the purpose of doing a general electrical construction business. The incorporators are: M. E. Woolridge, W. R. Kimberlin and E. E. Traweelmall.

THE SOUTHERN ELECTRIC LIGHT & POWER SUPPLYING CORPORATION, of Norfolk, Va., has been incorporated for the purpose of dealing in electrical supplies. The officers are: A. D. Newcomb, president; T. R. Calls, vice-president; W. J. Simpson, Jr., secretary and treasurer, all of Norfolk, Va.

THE TERRE HAUTE ELECTRICAL PORCELAIN COMPANY, of Terre Haute, Ind., has been incorporate,d with a capital stock of $25,000, to manufacture and sell electrical porcelain. The incorporators are William H. Glover, J. G. Hamilton and E. R. Coleman.

THE UNITED ENGINE & MANUFACTURING COMPANY, of York, Pa., has been incorporated with a capital stock of $20,000. The directors are: Robert E. Manley, 505 Madison Avenue, York, Pa.; William D. Himes, of New Oxford, Pa., and O. S. Trone, of Hanover, Pa.

THE WHEELER-M'DOWELL ELEVATOR COMPANY, of New York, N. Y., has filed articles of incorporation with a capital of $25,000 to manufacture, install and repair hoisting machinery; also to manufacture and deal in electrical apparatus. The incorporators are: L. J. McDowell, F. A. Page and F. L. Harris, of New York, N. Y.

New Incorporations.

CHICAGO, ILL.—The Central Light Plant Company has been incorporated with a capital stock of $50,000 to operate electric light and gas plants. The incorporators are: M. J. Carvey, W. J. Stenson, R. D. Braden, J. V. Suneral and J. D. Campbell, all of Chicago, Ill.

GREENSBORO, N. C.—Articles of incorporation have been filed for the North State Hydro-Electric Company with a capital stock of $300,000 by A. C. Wyckoff, H. L. Parker and F. H. Briggs, all of Raleigh, N. C. It is stated that the company is a subsidiary of the Carolina Power & Light Company and the Yadkin River Power Company.

CLEVELAND, OHIO.—The Electric Utilities Company has been incorporated with a capital stock of $10,000 by A. L. Oppenheimer, W. N. Caldwell, Edward Younger, Leonard C. Loomis and F. J. Castle.

ALTUS, OKLA.—The Southern Electric Company has been incorporated with a capital stock of $10,000 by E. E. Traweek, W. R. Kimberlin and M. E. Wooldridge.

McALESTER, OKLA.—The Salisaw, McAlester & Southern Railway Company has been incorporated with a capital stock of $3,000,000 by William B. Freeman, John Cavanagh, M. J. Smith, William Fuller and A. F. Ringland, of McAlester. The company is capitalized at $3,000,000

and proposes to build an electric railway from Salisaw to McAlester, thence to Honey Grove, Tex., a distance of about 190 miles.

OKLAHOMA CITY, OKLA.—Articles of incorporation have been filed for the Butts Electric Company with a capital stock of $5,000 by W. B. Butts, C. B. Dillingham, C. G. Grimes, of Oklahoma City and L. C. Butts, of Shawnee, Okla.

FORWARD, R. F. D. SOMERSET, PA.—The Forward Electric Company has been granted a charter with a capital stock of $5,000. The directors are: R. C. Lightcap, 107 Allen Avenue, Knoxville, Pa.; S. M. Miller, Pittsburgh, Pa., and A. L. Davis, of Oakland, Pittsburgh, Pa.

HANOVER, PA.—The Hanover Power Company has been incorporated with a capital stock of $5,000 and the following directors: C. J. Kirschner, of Hazleton, Pa., treasurer; Alvan Markle and W. H. Lavall, all of Hazleton, Pa.

HARRISBURG, PA.—Charters have been granted by the Secretary of State to the following companies: The Suburban Electric Company, of East Coventry; the Suburban Electric Company, of East Pikeland, and the Suburban Electric Company, of East Vincent, all in Chester County; the Suburban Electric Company, of Upper Providence, and the Suburban Electric Company, of Limerick Township, Montgomery County. The offices of the companies are located in Pottstown. The directors are: H. M. Blake, 223 South Third Street, Philadelphia, Pa., treasurer; Aaron S. Lord and Herbert G. Williams, of Pottstown, Pa., Each company is capitalized at $5,000.

HAZLETON, PA.—Articles of incorporation have been filed for the Wright Power Company, with a capital stock of $5,000. The directors are: C. J. Kirschner, of Hazleton, Pa., treasurer; Alvan Markle and A. F. Harger, both of Hazleton, Pa.

HEBRON, PA.—The Hebron Electric Light & Power Company has been chartered with a capital stock of $5,000. The directors are: Daniel Weaver, of Lebanon, treasurer; Henry Weaver, of Avon, Pa.; John S. Weaver, of El Paso, Tex.; Jacob B. Weaver, and Raymond S. Bicksler, all of Lebanon, Pa.

KULPSVILLE, PA.—The Towamencin Electric Company has been granted a charter with a capital stock of $5,000. The directors are: Joseph Becker, of Kulpsville, Pa., treasurer; Harry Goodman, Solomon W. Goodman, of Philadelphia, Pa.

MADISON, PA.—The Madison Borough Electric Company has been chartered with a capital stock of $5,000. The directors are: H. C. Miller, of McKeesport, Pa., treasurer; J. S. Tannehill, of Cannonsburg, Pa., and A. E. DuBois, of Pittsburgh, Pa.

MOUNT LEBANON, PA.—The North Irwin Electric Company has been granted a charter, with a capital stock of $5,000. The directors are: C. W. Scheck, of Mount Lebanon, Pa., treasurer; W. F. Craig, of Swissvale, Pa., and S. M. Miller, of Pittsburgh, Pa.

MOUNT PLEASANT, PA.—The Mount Pleasant Township Electric Company has been granted a charter, with a capital stock of $5,000. The directors are: E. B. Beach, Hotel Hamilton, N. S., Pittsburgh, Pa.; A. L. Davis, Oakland, Pittsburgh, Pa., and William H. Larimer, of Wilkinsburg, Pa.

OLYPHANT, PA.—The Lackawanna Light, Heat & Power Company has filed articles of incorporation with the Secretary of State. The directors are: Alvin Markle, of Hazleton, Pa.; Louis W. Healy, of Scranton, Pa., and James Butler, of Moosic, Pa.

PHILADELPHIA, PA.—The Ideal Light Company has been incorporated with a capital stock of $10,000 and the following directors: Julian L. Van Thuyne, 425 Vine Street, Philadelphia, Pa.; Wirt W. Woolverton and Charles F. Wallace, both of Philadelphia, Pa.

PHILADELPHIA, PA.—The Chelton Electric Company has been incorporated with a capital stock of $10,000. The directors are: Alfred M. North, 117 West Chelten Avenue, Philadelphia, Pa., treasurer; Charles C. Aeugle, John H. Nash and James A. McLaughlin, all of Philadelphia, Pa.

SCRANTON, PA.—Articles of incorporation have been filed for the People's Light, Heat & Power Company with the Secretary of State. The directors are: Alvin Markle, of Hazleton, Pa.; C. D. Simpson, and Louis W. Healy, of Scranton, Pa.

SCRANTON, PA.—The Pioneer Electric Company has been granted a charter. The directors are: C. D. Simpson, of Scranton, Pa.; Alvan Markle, of Hazleton, Pa., and James Butler, of Moosic, Pa.

TARENTUM, PA.—The Tarentum, Brackenridge & Butler Street Railway Company has been granted a charter with a capital stock of $100,000 for the purpose of constructing a railway 2 miles in length. The directors are: J. M. Griffith, of Tarentum, president; Otto Sontam, C. H. Battey, F. Flaggenmeier, of Tarentum; C. N. Schad, of Saxonburg, and J. C. Smith, of Brackenridge.

TYRONE, PA.—The Lower Tyrone Electric Company has been incorporated with a capital stock of $5,000 and the following directors: C. C. McBride, 32 Chapman Street, Ingram, Pa.; Byron Trimble, of Pittsburgh, Pa., and C. W. Scheck, of Mount Lebanon, Pa.

TYRONE, PA.—The Upper Tyrone Electric Company has been chartered with a capital stock of $5,000. The directors are: C. V. Scheck, of Mt. Lebanon, Pa., treasurer; A. E. DuBois, and E. M. Balsinger, of Pittsburgh, Pa.

WILKES-BARRE, PA.—The Wilkes-Barre Township Power Company has been chartered with a capital stock of $5,000. The directors are: C. J. Kirschner, of Hazleton, Pa., treasurer; Alvan Markle and C. B. Houck, of Hazleton, Pa.

WILKES-BARRE, PA.—The Wilkes-Barre Power Company has been granted a charter, with a capital stock of $5,000. The directors are: C. J. Kirschner, treasurer, of Hazleton, Pa.; Alvan Markle and C. B. Houck, all of Hazleton, Pa.

JOHNSON CITY, TENN.—The Elizabethton, Milligan & Johnson City Electric Railroad Company has been incorporated with a capital stock of $25,000 to construct an electric railway from Johnson City to Elizabethton, via Milligan, a distance of 8 miles. The incorporators are: W. G. Payne, James H. Smith, A. B. Brannon, W. C. Burchfield, J. N. Inders and J. G. Burchfield.

LENOIR, TENN.—The Lenoir Light & Power Company has been chartered with a capital stock of $10,000 by T. C. Foster, J. R. Browder, H. C. Foster, J. E. Foster and S. P. Witt.

ALVIN, TEX.—Articles of incorporation have been filed for the Alvin Ice, Light & Power Company with a capital stock of $15,000 by W. R. Stockwell, S. O. Smith, B. S. Williams and others..

GRANBURY, TEX.—The Granbury Water, Light, Ice & Power Company has been incorporated with a capital stock of $30,000 by R. Vickery, W. T. Pittman and James W. Rockaday.

TEMPLE, TEX.—The Southwestern Traction Company has been granted a charter with a capital stock of $165,000. The company proposes to construct and operate an interurban railway between Temple and Belton, and also to operate lines within each city. The incorporators are, A. F. Bentley, P. L. Downs, W. S. McGregor, W. C. Haag and W. G. Bentley.

TYLER, TEX.—The Talbert Telephone Company has been incorporated with a capital stock of $25,000 by J. A. Talbert, J. C. Smith and M. Starnes.

SPOKANE, WASH.—Articles of incorporation have been filed for the Mountain Lake Power & Irrigation Company by T. Z. and L. T. Gillett and C. T. Camplan. The company proposes to take over the Carp Lake project, near Goldendale, and will irrigate about 10,000 acres.

LOGAN, W. VA.—Articles of incorporation have been filed for the Logan Electric Company with a capital stock of $25,000 by W. F. Bevill, Charles Bennett, S. M. Bisant, Naaman Jackson and Frank R. Hurst, all of Logan. The company proposes to generate and sell electricity for lamps and motors.

ROMNEY, W. VA.—The Romney Consolidated Telephone Company has been incorporated with a capital stock of $25,000 by John J. Cornwell, G. P. Miller and J. Sloan Kuykendall, of Romney; H. W. Miller, of Paw Paw, W. Va., and S. L. Hoover, of Harrisonburg, Va.

SISTERSVILLE, W. VA.—The Tyler Traction Company has been granted a charter by the Secretary of State to build an electric railway from Sistersville, via Middlebourn, to Shirley. The company is capitalized at $500,000.

FRIESTADT, R. F. D. THIENSVILLE, WIS.—The Ozaukee-Washington Telephone Company has been chartered with a capital stock of $50,000 by P. W. Kraemer and others.

Personal.

PROF. ALEXANDER GRAHAM BELL returned on May 8 from a trip around the world.

PROF. ELIHU THOMSON will be the chief speaker at a banquet to be given by the Electrical Society of the Massachusetts Institute of Technology on May 11.

MR. ALBERT SCHEIBLE has been chosen president of the Purdue Association, of Chicago, an organization in which the electrical engineering graduates of Purdue have always been prominent.

MR. G. K. HEYER, of the Western Electric Company, will deliver an address before the Central Railway Club at Hotel Statler, Buffalo, N. Y., on May 12, his subject being, "Train Dispatching by Telephone."

DR. SVANTE ARRHENIUS, president of the Nobel Physical Institute, of Stockholm, will speak on "Electrolytic Dissociation" at a banquet to be given in his honor in Chicago on May 12 by the Chicago branch of the American Chemical Society.

MR. FRED M. LEGE, JR., general manager and chief engineer of the Brush Electric Light & Power Company, of Galveston, Tex., has been appointed to a similar position with the Galveston Gas Company, which is owned by the same interests as the electric company.

PROF. JOHN H. HUNT, of the department of electrical engineering of the Ohio State University, delivered an address on the subject "Variable-Speed Generators" before the Worcester Polytechnic Institute Branch of the American Institute of Electrical Engineers on May 5.

MR. WILLIAM K. FREUDENBERGER, who has been electrical engineer for the Steptoe Valley Smelting & Mining Company, McGill, Nev., for the past twenty-five years, has been appointed engineering expert for the Public Service Commission of Nevada, effective May 15.

MR. CHARLES A. HOBEIM, who has been with the United Railways Company of St. Louis for the past eight years, has been appointed superintendent of power stations for this company, to succeed Mr. E. D. Smith, who is now serving as chief engineer of the Board of Education of St. Louis.

MR. HENRY FLOY delivered a lecture on the Panama Canal before the Middletown Scientific Association, Middletown, Conn., on May 2. The lecture was illustrated with lantern slides from photographs mainly taken by Mr. Floy while on the Isthmus with the American Society of Civil Engineers during March.

MR. J. E. COWLES, formerly electrical superintendent of the Little Rock (Ark.) Railway and Electric Company, is now located at Shreveport, La., as electrical superintendent of the Shreveport Gas & Electric Company. Mr. Cowles was succeeded at Little Rock by Mr. C. E. Rose, formerly of the contract department.

MR. ROBERT T. LOZIER has become associated with Kountze Brothers, bankers, New York, for the handling of securities of well-established public-utility corporations. Mr. Lozier has been a full member of the American Institute of Electrical Engineers for the past eleven years and is at present president of the New York Electrical Society.

COL. W. H. CHAPMAN, vice-president and general manager of the Houston Lighting & Power Company, is recovering from a six weeks' illness of typhoid fever. Colonel Chapman is now past seventy years of age, but except for his recent illness has continued active in the administration of the business affairs of his company for the past sixteen years.

MR. S. G. McMEEN, of Chicago, Ill., who has just completed the installation of the automatic telephone system in San Francisco, on May 1 addressed the students of Throop Polytechnic Institute. The subject of the address was "The Work of the Telephone Engineer," with special reference to conditions found in San Francisco immediately following the earthquake and fire of 1906.

MR. ANGUS S. HIBBARD, who is leaving Chicago to become associated with President Vail, of the American Telephone & Telegraph Company in New York, was the guest of honor at several going-away parties before his departure. The Wisconsin Society of Chicago gave him a meat dish, explaining that a loving cup might lead to temptation, while from the executive committee of the Chicago Association of Commerce Mr. Hibbard received a gold-mounted baton in recognition of his musical ability.

MR. W. M. WHITE, formerly in charge of design for the I. P. Morris Company, of Philadelphia, has become associated with the Allis-Chalmers Company as manager and chief engineer of the hydraulic turbine department. During the past ten years Mr. White designed the hydraulic machinery for some of the largest hydroelectric installations in the country, including the plants of the Hydraulic Power Company and the Toronto Power Company of Niagara Falls, the Great Western Power Company of California, the Washington Power Company of Spokane, Wash., and the Shawinigan Falls Power Company of Montreal, Canada.

MR. CARL A. SYLVESTER has resigned as general manager of the Boston (Mass.) Suburban Electric Companies to become assistant to the general manager of the Rio de Janeiro Tramway, Light & Power Company, Rio de Janeiro, Brazil. Mr. Sylvester will succeed Mr. Walter Pearson at Rio de Janeiro and will leave Boston about June 1, 1911, to enter upon his new duties. Mr. Sylvester, who was born in Newton Center, Mass., was educated in the public schools at that place. He graduated from Harvard in 1902, and immediately entered the employ of the Newton system of street railways and worked in the shops and in the operating and construction departments. He also served for a time with the power department. In 1903 he was appointed assistant general superintendent of the Boston Suburban Electric Companies and later entered the general offices of the company in connection with the purchasing of supplies and as acting paymaster. In 1904 he was made assistant to the general manager. He received the title of assistant general manager in 1906. In September, 1909, Mr. Sylvester was appointed general manager of the Boston Suburban Electric Companies to succeed Mr. Matthew C. Brush, resigned.

MR. B. A. BEHREND, intimately connected with the electrical engineering profession for the last twenty years, whose articles on the "Induction Motor" in our columns in the year 1900 represented the first presentation to the American engineer of the method of treatment of this machine now universally employed, has opened an office for engineering consultation in the John Hancock Building, Boston. As chief engineer of the Bullock Electric Manufacturing Company, Cincinnati, Ohio; as chief engineer of the electrical department of the Allis-Chalmers Company, which he started and organized, and as consulting engineer of the Canadian branches of these companies, Mr. Behrend has for a long time been a prominent figure in the electrical industry of this country. During the last two and a half years, as advisory engineer of the Westinghouse Electric & Manufacturing Company, Pittsburgh, he has been in charge of the power engineering department of that company. Among Mr. Behrend's prominent clients are the Westinghouse Electric & Manufacturing Company and the Niagara Falls Hydraulic Power & Manufacturing Company, and in the past he has given advice to the Carnegie Steel Company and other subsidiaries of the United States Steel Corporation. The large electrical generators in the gas-engine plants of the Illinois Steel Company, the American Steel & Wire Company, the Carnegie Steel Company, and the Indiana Steel Company, Gary, Ind., were designed by Mr. Behrend, who also solved most successfully, for the first time in this country and on the greatest scale ever known, the problem of parallel operation of large gas-engine units. Fifteen 3000-kva units operate in multiple at Gary, five at the furnaces of the Carnegie Steel Company at Rankin, Pa., four at the South Works of the Illinois Steel Company in Chicago, and four 1200-kva units at the plant of the American Steel & Wire Company, at Cleveland, representing an aggregate of almost 100,000 kva and including almost all the important subsidiaries of the United States Steel Corporation. Mr. Behrend is a man of broad outside interests. He is a director in a large manufacturing company and he is interested in political, financial and economic questions. He has written a book on the theory of the induction motor and many other scientific and engineering papers. He received a gold medal for his work at the Louisiana Purchase Exposition in St. Louis, 1904, while his company received a grand prize. He has lectured at many universities, including Leland Stanford, University of Wisconsin, McGill University and the Massachusetts Institute of Technology. He is fond of educational problems, on which he has frequently written and spoken. He is a member of the Engineers' Club, New York, a fellow of the American Association for the Advancement of Science, a member of the American Society of Civil Engineers, the American Society of Mechanical Engineers and of the American Institute of Electrical Engineers.

Obituary.

MR. JOHN J. NATE, of Minneapolis, Minn., very well known to telephone men of the Central West, died at the home of his daughter, in Winona, Minn., on April 30. He was born in 1857, and from 1878 to 1895 was employed by the Chicago Telephone Company, being purchasing agent for much of that time. In the year last mentioned he entered the Independent telephone manufacturing field. He was connected with several companies, and for the last nine years had been manager of the Minneapolis office of the Stromberg-Carlson Telephone Manufacturing Company.

Trade Publications.

STREET-CAR OPERATION.—In a treatise for street-railway men being distributed by the Sangamo Electric Company a number of schemes are suggested for comparing equipment, operators, checking line losses, etc. The book should prove of interest to every manager desiring to secure greater economy.

CENTRAL STATION SPECIALTIES.—Catalog No. 6, of the G. & W. Electric Specialty Company, 640 Jackson Park Avenue, Chicago, is a useful and handsome publication of 72 pages profusely illustrated, describing specialties for central-station use. These include potheads of various kinds, sometimes in combination with junction boxes and series switches; safety line disconnectors, series cut-outs, underground switching boxes, high-voltage fuse blocks, high-potential detectors, lubricating brushes, etc. Dimensions and prices are given, and there are many explanatory diagrams. An interesting feature is a dictionary of terms. For instance, a pothead is said to be "a device for sealing in a cable against moisture where taps are made to the cable." An alphabetical index would have made this useful catalog more easy to consult.

DECORATIVE STREET LIGHTING.—"The Illumination of the Streets" is the title of a brochure issued by the Holophane Company. While intended for popular distribution rather than for engineers, the booklet contains some valuable data on the subject and should be appreciated by all who are interested in the so-called "boulevard lighting" installations. The street-lighting units described have several definite advantages over other equipment, according to the data given. The units are designed to give the maximum of even illumination upon the streets and sidewalks with the minimum of objectionable glare. The comparative photometric curves published would indicate that the units are successful in both directions. Artistic appearance, however, has not in this case been sacrificed to engineering considerations. The units are especially attractive and the various designs have a wide range of adaptability. In view of the great interest everywhere manifested in improved street lighting, this publication should prove of more than passing interest.

BUSINESS NOTES.

MR. EDWIN W. HAMMER, electrical and mechanical engineer and patent expert, has moved his offices from 120 Broadway to 55 John Street, New York City.

WALTER B. SNOW, Boston, Mass., has recently added to his publicity engineering staff John S. Nicholi, late of the New York Edison Company, and formerly acting manager for F. W. Horne, importer of American Machinery at Yokohama, Japan.

WALPOLE RUBBER COMPANY.—Mr. E. C. Green has again become associated with the Walpole Rubber Company, in the capacity of general purchasing agent of the consolidated companies, with headquarters at the factory office in Walpole, Mass.

WHEELER MANUFACTURING COMPANY.—Mr. F. S. Broadhurst, formerly in the employ of the C. H. Wheeler Manufacturing Company of Philadelphia, and recently with the Westinghouse Machine Company, has rejoined the former company, assuming the position of sales manager, with headquarters at Philadelphia.

THE CUTLER-HAMMER MANUFACTURING COMPANY has established a department to be devoted exclusively to the design and manufacture of electrical appliances for industrial heating. The department will be under the direct supervision of Mr. W. S. Hadaway, Jr., with headquarters at the factory, 144th Street and Southern Boulevard, New York.

BLANCHARD MACHINE COMPANY.—Mr. Wolcott Remington, designer and manufacturer of oil engines, has associated himself with the Blanchard Machine Company, Cambridge, Mass. He is now engaged in designing a line of stationary and marine oil engines ranging in rating from 10 hp to 100 hp, which will be manufactured under the name of the Blanchard oil engine.

THE TEL-ELECTRIC COMPANY, Houston, Tex., is just completing the occupancy of its new five-story warehouse and storeroom building for general electrical supplies at 602 Preston Avenue. The new warehouse building affords provision for carrying the complete stock of electric lighting and telephone supplies which the company maintains at Houston for the south Texas trade. The distance of Houston from Northern and Eastern electrical distributing points makes necessary large reserve stocks, requiring about 50 per cent more space than would be necessary under similar conditions in less remote localities. Mr. M. B. Wheeler is general manager of the company.

CUTLER-HAMMER DINNER.—The recently issued souvenir of the 1911 annual dinner of the Cutler-Hammer Manufacturing Company, at the Milwaukee Club, recalls an interesting and carefully planned social event. The souvenir is in the shape of a regular bulletin of the company, arranged for filing, and shows that the Cutler-Hammer "boys" know how to play as well as to work. The diners were arranged around a circular table, the suggestion being that each represented the segment of a rheostat. The menu card is printed in the outline of an electric water heater, and there are original verses parodying popular songs, and cartoons of the gentlemen present, accompanied by alleged biographies. The "round robin" of those present embraces the names of H. H. Cutler, F. T. Taylor, A. B. Hubbell, R. M. VanVleet, A. W. Berresford, C. E. Watrous, S. M. McFedries, T. E. Barnum, R. C. Fenner, F. S. Wilhoit, L. L. Tatum, R. H. Mansfield, A. G. Pierce, C. T. Henderson, C. L. Benjamin, F. L. Pierce, A. P. Munning, N. S. Hopkins and H. F. Vogt. One judges, from the name on the contact-arm in the "arrangement of segments," that H. J. Wiegand was toastmaster. It is also a safe bet that Mr. Benjamin had something to do with "roasting" everybody in the souvenir.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED MAY 2, 1911.

[Conducted by W. F. Bissing, Patent Law, 2 Rector St., N. Y. City]

990,853. ADJUSTABLE SUPPORT FOR VAPOR LAMPS; S. E. Flichtner, Englewood, N. J. App. filed Jan. 9, 1905. Tilting frames for starting vapor electric lamps, having a reflector to throw the radiation in one general direction.

990,859. APPARATUS FOR IGNITING MINERS' SAFETY LAMPS; E. A. Hailwood, Morley, England. App. filed Oct. 16, 1906. A casing closed by a door to receive the lamp, door controlling contacts for the ignition circuit.

990,869. ELECTRIC SWITCH-OPERATING DEVICE; B. Henrard, Liège, and Léon Levêque, Antwerp, Belgium. App. filed Feb. 3, 1910. For operating the switches of railroads electrically by means of rubber contacts secured to the current conductor which come in contact with the contact strips at intervals along the track, thus throwing electromagnets for actuating the switches.

990,870. TROLLEY GUARD; C. Heron, Chicago, Ill. App. filed Aug. 9, 1909. Prevents the wheel from leaving the wire. The pole has a hollow shaft rigidly mounted on its fork and projects beyond both sides thereof; a spindle passes through the shaft; guard members are loosely mounted on the projecting portions of the shaft and are rigidly connected to the spindle.

990,875. ELECTRIC STEAM GENERATOR AND HUMIDIFIER; L. B. Holliday, Beckley, and E. J. Weidensall and George R. Kerbs, Wickham, West Va. App. filed March 22, 1910. For heating water by electricity, the electrodes dipping into a container for the water, the container being mounted upon a movable platform.

990,879. TILTING LAMP; F. H. Von Keller, New York, N. Y. App. filed Sept. 22, 1905. Tilting vapor lamp, tilted by an electromagnet, whose pole piece attracts an armature secured to the tilting frame to raise it from an inclined to a horizontal position repeatedly if desired.

990,893. PILOT CELL FOR ELECTRIC STORAGE BATTERIES; R. Macrae, Chicago, Ill. App. filed Nov. 19, 1909. A supplemental wall forms a compartment to accommodate measuring instruments, the compartment communicating with the electrolyte and having an opening sealed by a glass plate to view the instruments.

990,927. ELECTRICALLY HEATED COOKER; C. E. Terwilliger, Santa Cruz, Cal. App. filed Oct. 15, 1910. Self-cooker with electric preheating, including outer and inner shells with heat-retaining filling and an electric resistance beneath the inner receptable.

990,951. FLEXIBLE ELECTRICAL BRUSH OR COLLECTOR; Ralph Henry Barbour, Tiltwood, Eng. App. filed Sept. 12, 1910. A plurality of fine wire strands of high conductivity, with an encircling armor formed of good conductors, spaced from the fine wire, and of a larger gage.

990,958. ELECTRIC LOCOMOTIVE; W. Cooper, Pittsburgh, Pa. App. filed Sept. 10, 1909. Driving gear and jack-shaft connection for varying the speed ratio between the motor actions and driving actions.

990,964. INDUCTION MOTOR; I. De Kaiser, Wilkinsburg, Pa. App. filed July 6, 1908. Secondary rotor winding for induction motors comprising two sets of spirally superposed plates with teeth in the four slots, the inner ends abutting against each other.

990,966. ELECTRIC RAILWAY VEHICLE; G. M. Eaton, Wilkinsburg, Pa. App. filed Dec. 24, 1909. Jack-shaft parallel to the driving wheels with large driving motors, gears between the jack shafts and motors, side-rod connections between the jack-shafts, and another jack-shaft from which sliding-rod connections run to the driving wheel.

990,967. MERCURY CIRCUIT-BREAKER AND SHUNT FOR SIGNAL RELAYS; E. A. Everett, Detroit, Mich. App. filed July 20, 1908. Automatic circuit-breaker and shunt for railway signals, including a main shunt across the track, circuit controllers in the track circuits and in the shunts which break the track circuit and main shunt and close the emergency shunt, to afford a path for earth currents.

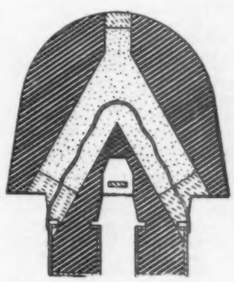
990,971. RAILWAY SIGNALING APPARATUS; A. Forster, Gorlitz, Germany. App. filed July 20, 1908. Semaphore operated by an electric circuit whose terminals end in a contact section adjacent to one of the tracks, which contact section is operated by wheels on the locomotive.

990,972. TELEPHONE CALL DISTINGUISHER; K. W. Gale, Los Angeles, Cal. App. filed Feb. 16, 1909. Desk telephone with call indicator containing an electromagnet in series with the ringing circuit, which actuates a pivoted indicator.

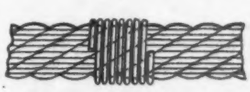
990,985. SYSTEM OF CONTROL; R. P. Jackson, Wilkinsburg, Pa. App. filed Oct. 20, 1904. Makes use of main switches, interlocking switches operated thereby, relay switches for operating the main switches, the relay switches being governed by a master switch and by the interlocking switches. The time period between successive operations is increased by the use of controlling switches into the circuits of which high inductances are included, so arranged that a reversal of the direction of the magnetic fluxes in the iron cores thereof occurs each time the devices are thrown into circuit so as to use residual magnetism.

990,987. REEL FOR ELECTRIC CABLES AND THE LIKE; D. J. Jorden, Cleveland, Ohio. App. filed Oct. 9, 1909. For winding electric cables on portable machines such as mine locomotives. A fluid pressure motor operates the reel under a constant pressure.

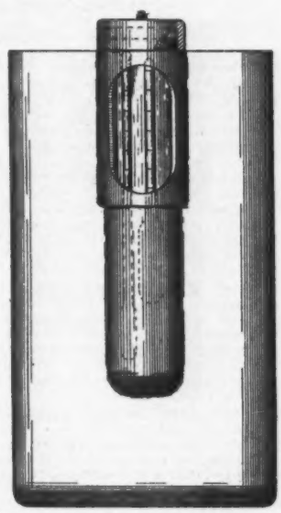
990,999. POWER-TRANSMISSION APPARATUS; J. J. McGuire and H. H. Graham, Oak Park, Ill. App. filed July 9, 1909. For printing-press motors. Two motors are used, one driving at normal high speed, the other to start the press with a clutch coupling controlled by electromagnets for throwing in either motor.



991,007.—Electric Fuse.



990,951.—Flexible Electrical Brush or Collector.



990,893.—Pilot Cell for Electric Storage Batteries.

991,004. METER-TESTING SERVICE CUT-OUT; T. E. Murray, New York, N. Y. App. field Dec. 8, 1909. A plurality of separate recesses with circuit terminal plates in the recesses, contact plates extending outwardly therefrom and disposed in line across the recesses, main and branch conductors, circuit connections between the terminal plates and conductors and a removable bridge piece to be received upon two of the contact plates.

991,005. FUSE CASE; T. E. Murray, New York, N. Y. App. filed Oct. 17, 1910. A fuse case whose walls are of non-conducting fibrous material reinforced with metal.

991,006. ELECTRIC CUT-OUT; T. E. Murray, New York, N. Y. App. filed Nov. 19, 1910. For indicating the condition of the fuse by means of an auxiliary fuse in a carrier seated in a wall of the base block, the terminals of the auxiliary fuse being connected with contacts for the carrier, which connect with contacts on the main fuse case.

991,007. ELECTRIC FUSE; T. E. Murray, New York, N. Y. App. filed Nov. 26, 1910. For preventing the breakage of the fuse case by the blowing of the fuse by arranging the strip in a V-shaped chamber so that the localized blowing point will lie near the apex of the angle of the V.

991,008. ELECTRIC FUSE CASE; T. E. Murray, New York, N. Y. App. filed Dec. 13, 1910. The end of the fuse case consists of refractory insulating material with a doubled-over metal plate in the end piece, the case being formed of a metallic plate bent to form

two tubular shells, one inclosing the other, with an air space between.

991,030. ELECTRICAL CONNECTION; S. Sedoff, Montclair, N. J. App. filed Oct. 6, 1910. For spark plugs and the like. The connections consist of a plate which can be screwed to the support and which carries a post on which a nut is mounted for securing the wire. The post has a split end with a spring action for engaging the sides of a metal block carrying the wire.

991,038. ELECTRIC LOCOMOTIVE; N. W. Storer, Pittsburgh, Pa. App. filed Jan. 3, 1910. Driving connection between electric motors and the driving wheels of a locomotive by means of two jack-shafts directly below the motor axles to which they are gear-connected

991,039. TROLLEY-POLE-OPERATING MEANS; A. A. Strange and W. Anderson, Memphis, Tenn. App. filed Aug. 12, 1909. Pneumatically controlled hollow trolley pole communicating with a piston chamber with a second piston in the trolley pole which carries the trolley wheel, for holding the wheel against the wire, but permitting it to fall out of the path of the suspending wires when it becomes disengaged from the trolley.

991,040. PRESSURE-CONTROLLED OPERATING MEANS FOR TROLLEY POLES; A. A. Strange and W. Anderson, Memphis, Tenn. App. filed Oct. 28, 1909. Trolley pole with cylinder and piston rod for operating it, connections between the rod and pole to move the latter into opposite position when the pressure is admitted to the cylinder, the rod cutting off the pressure supply when the pole jumps the track.

991,044. RESERVE EMERGENCY LANTERN; W. H. Adams, Sound Beach, Conn. App. filed June 18, 1910. Has a base carrying the batteries, a reflector, a switch and a cover with a lamp inside of the reflector.

991,053. ELECTRIC FIRE ALARM; A. C. Farley, Shinglehouse, Pa. App. filed Nov. 15, 1909. A casing containing a sliding rod, a signal, a wire leading from the signal to the rod, an expanding member carrying a contact positioned between the ends of the rod and the wire, a second wire secured to the contact and a battery secured to the last-mentioned wire.

991,080. SYSTEM OF ELECTRICAL DISTRIBUTION; R. M. Palmer, Cambridge, Mass. App. filed Oct. 30, 1909. Improvement on patent 807,960. A high-voltage circuit, a low-voltage circuit containing the translating device, and a relay governed by the high-voltage circuit, a relay in the low-voltage circuit and a circuit controller governed by the last relay.

991,105. ELECTRICAL SYSTEM OF DISTRIBUTION; W. A. Turbayne, Lancaster, N. Y. App. filed Feb. 8, 1908. The main generator, a circuit, a battery to be charged from the circuit, means for regulating the generator and means connected to the battery terminals and to a point within the battery for regulating the regulator to give a tapering charging current responsive to variations in the battery condition.

991,106. ELECTRICAL SYSTEM OF DISTRIBUTION; W. A. Turbayne, Lancaster, N. Y. App. filed May 2, 1908. Main generator, a battery, an auxiliary generator having a field for fixing the polarity of the main generator, and means for reversely connecting the field coil when the voltage of the battery rises to a given value.

991,107. ELECTRICAL SYSTEM OF DISTRIBUTION; W. A. Turbayne, Lancaster, N. Y. App. filed July 11, 1908. A combination of a distribution circuit, a storage apparatus connected to the circuit, a regulating dynamo therefor, an exciter for the dynamo, and a dynamo-electric machine coacting upon the field of the regulating dynamo responsive to fluctuations in the circuit.

991,108. ELECTRICAL SYSTEM OF DISTRIBUTION; W. A. Turbayne, Lancaster, N. Y. App. filed Dec. 28, 1908. A source of electromotive force governed by an auxiliary dynamo-electric machine, a variable resistance in series with the work circuit and means for regulating the dynamo responsive to variations in the resistance, the resistance being controlled in accordance with voltage fluctuations.

991,109. ELECTRICAL SYSTEM OF DISTRIBUTION; W. A. Turbayne, Lancaster, N. Y. App. filed Jan. 16, 1909. Car-lighting system with variable-speed generator, whose voltage responds to electrical fluctuations in its output and a coil operating on failure of the regulator to cause the regulator to regulate the voltage of the generator.

991,110. ELECTRICAL SYSTEM OF DISTRIBUTION; W. A. Turbayne, Lancaster, N. Y. App. filed Jan. 27, 1909. Car-lighting system with shunt-wound generator driven at a variable speed by the movement of the car, a work circuit and storage battery fed by the generator, a regulator in series with the field and having a controlling coil, and a vibrating armature for connecting the coil across the generator, with a magnet controlled by the voltage fluctuations to control the armature.

991,111. ELECTRICAL SYSTEM OF DISTRIBUTION; W. A. Turbayne, Lancaster, N. Y. App. filed Feb. 24, 1909. Car-lighting system with generator on one train unit, batteries on other train units, a feeding conductor for the work circuits, and charging conductor for the batteries, a common return for both, with a switch for disconnecting the batteries responsive to a decrease in the voltage of the generator.

991,112. ELECTRICAL SYSTEM OF DISTRIBUTION; W. A. Turbayne, Lancaster, N. Y. App. filed May 16, 1909. Car-lighting system with variable speed generator, work circuit and translating devices, a storage battery supplied simultaneously thereby with means for regulating the generator to maintain its voltage constant when there is no load and substantially constant but at a less value with some load.

991,113. CHARGING APPARATUS; W. A. Turbayne, Lancaster, N. Y. App. filed Aug. 25, 1909. Storage-battery-charging system for car lighting, with a variable resistance and a fixed resistance in series with each other and the battery, a second fixed resistance in parallel with the variable resistance, the variable resistance being controlled in response to current changes in the second resistance.

991,114. ELECTRICAL SYSTEM OF DISTRIBUTION; W. A. Turbayne, Lancaster, N. Y. App. filed Nov. 5, 1909. Train-lighting system with automatic voltage regulator, including a generator, a regulating armature for the voltage of the generator, batteries in work circuits, and a coil to cause the generator voltage to increase as more work circuits are added.

991,117. RELAY; P. Tune, Wilkinsburg, Pa. App. filed Oct. 19, 1910. Relay of the electromotor type whose movable part is of non-magnetic material which is caused to rotate by alternating currents flowing in the windings of two oppositely arranged magnets forming a stationary field.

991,129. ELECTRICAL CURLING IRON; G. W. Bibbens, Kansas City Mo. App. filed Aug. 31, 1908. Curling-iron tube in which is inserted a heating unit consisting of an inner tube around which a wire is coiled, an outer tube of insulating material fitting over the coil.

991,174. PROCESS FOR THE PRODUCTION OF REACTIONS IN GASES; O. Schonherr and J. Hessberger, Ludwigshafen-on-the Rhine, Germany. App. filed May 18, 1905. Produces electric arcs between a rotating and a stationary electrode, and spreads out the resulting gases so as to spread out the arcs for use in electric furnaces.

991,181. CONTROLLER FOR ELECTRIC MOTORS; F. T. Taylor, New York, N. Y. App. filed July 10, 1909. Controller for electric motors having in combination a plurality of contacts with a member for engaging and disengaging them and to stop the motor when disengaged, the motor being started when the member engages a contact, the contacts being of various sizes to control the operation.

991,189. SYSTEM OF CONTROL FOR ELECTRIC MOTORS; T. E. Barnum, Milwaukee, Wis. App. filed July 6, 1908. An overload device which may be made inoperative for a temporary period when the motor circuit is closed, with automatic means for indicating when the device is free to operate.

991,190. MOTOR CONTROLLER; T. E. Barnum, Milwaukee, Wis. App. filed Aug. 26, 1909. Gang switch, or set of circuit-breakers for starting a motor, with a circuit-breaker connected in the motor circuit and means necessitating the closing of the circuit-breaker prior to the operation of the switches.

991,206. CONTROLLER FOR ELECTRIC MOTORS; A. J. Horton, White Plains, N. Y. App. filed July 6, 1908. An automatically-operated main switch, a pilot switch for the main switch for slow speed of the motor and an automatic accelerator which responds when the pilot switch is moved to another position to increase the speed, the pilot switch having contacts included in the motor circuit for controlling the direction of current.

991,207. TROLLEY; F. H. Howard, Reading, Pa. App. filed Dec. 27, 1909. A hollow wheel with a rectangular bore, a pair of plates secured to a removable shaft passing through the wheel, the plates being curved at their edges to form ball races.

991,208. MULTIPLE NEEDLE HOLDER FOR ELECTROLYSIS; E. W. Johnson, Chicago, Ill. App. filed Feb. 14, 1910. Can be attached to the patient with an auxiliary clamp for securing it to the operating chair; includes a plurality of jointed arms each carrying a needle.

991,219. BURGLARY SAFEGUARDING APPARATUS; E. Maynard, Holyoke, Mass. App. filed April 18, 1910. Lamps are lighted at suitable circuits which run inside the store and are controlled by the doors and windows. The green lamp indicates safety and the red lamp entry by burglars.

991,231. TROLLEY; V. Pedersen, Turtle Creek, Pa. App. filed Feb. 13, 1911. Swiveled harp for trolley, including a socket, a pin in the socket which carries a harp plate in which plate a wheel is mounted.

991,234. TELEGRAPHY; I. Kitsee, Philadelphia, Pa. App. filed Feb. 20, 1906. For submarine cables. Two submarine cables have each a polarized relay at one terminal, one relay impressing upon the second cable positive and negative impulses, and the relay of the second cable impressing upon the first cable positive and negative impulses.

991,244. ELECTRICAL WATER HEATER; W. R. May, San Francisco, Cal. App. filed Sept. 28, 1910. A water heater with a valve plate, water-heating coils within the heating chamber of the vasing and an insulating block with perforations through which the water-heating coils are threaded, an inlet pipe, a valve for the discharge of water from the pipe into the heating chamber, and a rotary snap switch for releasing the valve when the switch is actuated.

991,247. ELECTRICALLY CONTROLLED RAILWAY SWITCH; B. Schlater, New Albany, Ind. App. filed June 28, 1909. The first car controls the track switch so that the second car cannot operate it.

991,260. AUTOMATIC TELEPHONE SYSTEM; V. Alexeeff, Ensell, Persia. App. filed June 19, 1908. For making connections between subscribers without calling up central by means of a selecting switch apparatus, including talking contacts, a series of rods, means operated by the line circuit for moving the rod corresponding to the calling telephone to and off the talking circuit, a local circuit, an arm driven by a motor, which arm carries an electromagnet which is brought to the rod corresponding to the telephone of the call subscriber, the magnet being excited by the local circuit.

991,304. MEANS FOR REPRODUCING ELECTRICAL VARIATIONS; P. C. Hewill, New York, N. Y. App. filed July 7, 1904. For operating vapor electric apparatus to reduce the burr on the positive electrode which causes a resistance and sometimes visible radiations. Utilizes a permanent magnet to shift the point where the current passes from the positive electrode and includes a receiver circuit with telephone and a source of electromotive force in circuit with the cathode of the apparatus and one of the anodes.

991,325. TELEGRAPHIC RELAY; I. Kitsee, Philadelphia, Pa. App. filed July 2, 1910. A relay with a movable and stationary contacts, one of which is of metal and the other of graphite.

991,357. PROCESS OF PRODUCING NITRIC-OXID FROM MIXTURES OF NITROGEN AND OXYGEN AND APPARATUS THEREFOR; H. Pauling, Gelsenkirchen, Germany. App. filed Sept. 27, 1910. Heats the mixed gases to a reacting temperature and permits them to expand without reduction of temperature.

991,372. AUTOMATIC FUSIBLE LIGHTNING ARRESTER; A. Reid, Colorado City, Col. App. filed Aug. 6, 1909. A lightning arrester with a housing, a plurality of fuses and a weighted lever connected at one end of each fuse, with means for connecting the fuses to the line wire and the lever to earth, including a wire with a bracket pivotally connected with each lever and a contact to engage the brackets as the fuses are broken.

991,384. ELECTRICAL RECIPROCATING ENGINE; W. A. Stedman, Millers, Nev. App. filed April 26, 1910. For operating the tamp bars of a stamp mill, by means of a solenoid with separate winding, an operating circuit and a rotary switch.

991,389. TROLLEY POLE; O. W. Swanson, New Haven, Conn. App. filed June 29, 1910. Pole with elongated bearing surface formed of one piece of continuous material bent upon its self to form a curved contact member for engagement with the trolley wire, the curvature of the member being such that the centre of curvature is between the base and the upper terminal.

991,423. TROLLEY-WHEEL-RESTORING DEVICE; J. D. Carey, New Haven, Conn. App. filed Jan. 18, 1911. A yoke with a roller mounted therein, a roller having an eccentric central portion, a central clearance notch and a spiral groove running from opposite ends, the device being attached to the wheel end of the pole.

991,431. CONTROLLER FOR ELECTRIC DRILLS; W. O. Duntley, Chicago, Ill. App. filed Sept. 7, 1906. A switch for an electric drill with a casing containing the switch and secured to the drill at one side of the usual grasping handle of the drill and a switch handle pivoted upon the lower end of the casing and adjacent to the grasping handle, the switch handle being connected to the main switch.